YAMATAKE

AUR350C
Advanced UV Relay
with Communications

User's Manual

Thank you for purchasing the AUR350C.
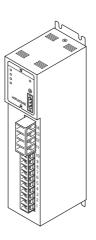
This manual contains information for ensuring the correct use of the AUR350C. It also provides necessary information for installation, maintenance, and troubleshooting.

This manual should be read by those who design and maintain equipment that uses the AUR350C. Be sure to keep this manual nearby for handy reference.

Yamatake Corporation

RESTRICTIONS ON USE

This product has been designed, developed and manufactured for general-purpose application in machinery and equipment.

Accordingly, when used in applications outlined below, special care should be taken to implement a fail-safe and/or redundant design concept as well as a periodic maintenance program.

- Safety devices for plant worker protection
- Start/stop control devices for transportation and material handling machines
- Aeronautical/aerospace machines
- Control devices for nuclear reactors

Never use this product in applications where human safety may be put at risk.

NOTICE

Be sure that the user receives this manual before the product is used.

Copying or duplicating this user's manual in part or in whole is forbidden. The information and specifications in this manual are subject to change without notice.

Considerable effort has been made to ensure that this manual is free from inaccuracies and omissions. If you should find an error or omission, please contact Yamatake Corporation.

In no event is Yamatake Corporation liable to anyone for any indirect, special or consequential damages as a result of using this product.

SAFETY PRECAUTIONS

■ About Icons

The safety precautions described in this manual are indicated by various icons. Please be sure you read and understand the icons and their meanings described below before reading the rest of the manual.

Safety precautions are intended to ensure the safe and correct use of this product, to prevent injury to the operator and others, and to prevent damage to property. Be sure to observe these safety precautions.

| ⚠ **WARNING** | Warnings are indicated when mishandling this product might result in death or serious injury. |
| ⚠ **CAUTION** | Cautions are indicated when mishandling this product might result in minor injury to the user, or only physical damage to the product. |

■ Examples

⚠	Triangles warn the user of a possible danger that may be caused by wrongful operation or misuse of this product. These icons graphically represent the actual danger. (The example on the left warns the user of the danger of electric shock.)
🚫	White circles with a diagonal bar notify the user that specific actions are prohibited to prevent possible danger. These icons graphically represent the actual prohibited action. (The example on the left notifies the user that disassembly is prohibited.)
⬤	Filled-in black circles instruct the user to carry out a specific obligatory action to prevent possible danger. These icons graphically represent the actual action to be carried out. (The example on the left instructs the user to remove the plug from the outlet.)

⚠WARNING

❗	The AUR350C is not equipped with the prepurge timer and sequence functions necessary for burner ignition. The overall equipment must be designed carefully, taking the timer and sequence functions into consideration.
🚫✋	Never touch any terminal of the AUR350C while power is being supplied. Doing so may cause an electric shock.
❗	Before wiring the AUR350C, be sure to turn the power OFF. Failure to do so may cause an electric shock.
🚫	Do not connect the solenoid valve to the high voltage side. If a ground fault occurs, the ground fault current may flow into the solenoid valve. The AUR350C will not be able to prevent the valve from opening and fuel from flowing out.
❗	The pilot and main burner ignition time must not exceed the ignition time specified by the burner or equipment manufacturer. If they do, fuel may accumulate in the combustion chamber to form an explosive mixture, causing a serious explosion hazard.
🚫✋	Never touch any terminal of the AUR350C during trial-run adjustment. Doing so may cause an electric shock.
❗	Before mounting or removing the AUR350C, be sure to turn the power OFF. Failure to do so may cause an electric shock.
🚫	Before starting the pilot turndown test or ignition spark response test, always check that all manual fuel valves are closed.
🚫	Do not start the actual operation unless the trial-run adjustment tests and tests specified by the equipment manufacturer are completed.
🚫✋	Terminal 11 (F) is electrically alive for 1 minute after the power to the AUR350C has been turned OFF. Never touch terminal 11 (F) immediately after the power has been turned OFF. Doing so may cause an electric shock.
❗	If the AUD300C detects a pilot flame that is too small to ignite the main burner, the AUR350C will not recognize a flame failure in the main burner. In this case fuel would flow continuously, causing a serious explosion hazard. To prevent such an occurrence, always perform the pilot turndown test carefully.
❗	When performing the pilot turndown test repeatedly, stop the equipment completely every time the pilot turndown test is completed in order to completely vent the unburnt gas or oil that has accumulated in the combustion chamber or flue. If unburnt gas or oil is not parged completely, an explosion may occur.

⚠ WARNING

❗	After the pilot turndown test has been completed, turn OFF the power switch to shutdown the power. Restore all test jumpers and limit/regulator settings to their previous states. If operation begins without the above steps, damage to the equipment, gas leak or explosion may result.
❗	Be sure the AUD300C does not detect ultraviolet rays other than those of the burner flame. If the AUD300C responds to other ultraviolet rays, flame failure in the burner will go unnoticed, allowing fuel to flow continuously, causing a serious explosion hazard.

⚠ CAUTION

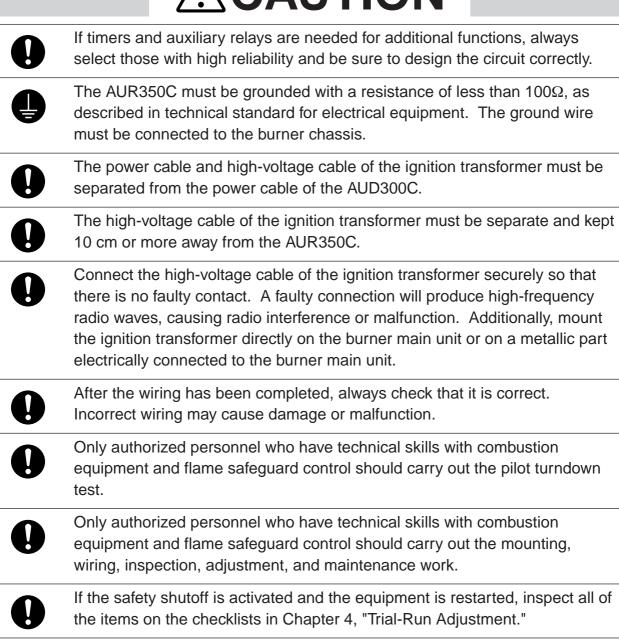|	
❗	The AUR350C is specially designed for intermittent burner operation (the system is started and stopped once or more within 24 hours) and continuous burner operation (the system continues combustion for 24 hours or longer). The AUD300C with a self-checking function must be used as a flame detector in combination with this unit.
❗	The AUR350C is equipped with important functions necessary to safely operate the equipment. Always operate the AUR350C according to the user's manual.
🚫	Do not install the AUR350C in the following places: • In the presence of chemicals or corrosive gas, such as ammonia, sulfur, chlorine, ethylene compound, acid, or others. • Where it is exposed to water drops or damp atmosphere. • Where it is exposed to high temperatures. • Where vibration continues for an extended period of time.
❗	Carefully perform the mounting and/or wiring work while referring to this user's manual, as well as the instruction manuals published by the equipment manufacturers.
❗	Carry out the wiring work in conformity with the specified standards.
❗	Always connect the power supply last. Otherwise, touching a terminal accidentally may cause an electric shock or damage.
❗	The load connected to each terminal must not exceed the rating shown in the specifications.
❗	Always supply electric power with the voltage and frequency stated on the model label of the AUR350C.

⚠CAUTION

❗	If timers and auxiliary relays are needed for additional functions, always select those with high reliability and be sure to design the circuit correctly.
⏚	The AUR350C must be grounded with a resistance of less than 100Ω, as described in technical standard for electrical equipment. The ground wire must be connected to the burner chassis.
❗	The power cable and high-voltage cable of the ignition transformer must be separated from the power cable of the AUD300C.
❗	The high-voltage cable of the ignition transformer must be separate and kept 10 cm or more away from the AUR350C.
❗	Connect the high-voltage cable of the ignition transformer securely so that there is no faulty contact. A faulty connection will produce high-frequency radio waves, causing radio interference or malfunction. Additionally, mount the ignition transformer directly on the burner main unit or on a metallic part electrically connected to the burner main unit.
❗	After the wiring has been completed, always check that it is correct. Incorrect wiring may cause damage or malfunction.
❗	Only authorized personnel who have technical skills with combustion equipment and flame safeguard control should carry out the pilot turndown test.
❗	Only authorized personnel who have technical skills with combustion equipment and flame safeguard control should carry out the mounting, wiring, inspection, adjustment, and maintenance work.
❗	If the safety shutoff is activated and the equipment is restarted, inspect all of the items on the checklists in Chapter 4, "Trial-Run Adjustment."
❗	When performing the maintenance and inspection of the burner, always carry out the pilot turndown test. Inspection must be carried out once a year or more frequently.
❗	When cleaning the burner, also clean the AUD300C.

Unpacking

Check the following items when removing the AUR350C from its package:

1. Check the model number to make sure you received the correct product.
2. Check for any obvious damage.
3. Check the contents of the package against the packing list to make sure that all items are included.

Handle the AUR350C and its accessories with care to prevent damage or loss of parts.

If there is some problem with your order, please contact your dealer immediately.

Name	Model No.	Q'ty	Remarks
Body	AUR350C Advanced UV relay with Communications	1	☞ See Chapter 8, "Specifications"
User's Manual *XXXXX XXXXX User's Manual XXXXX*	CP-SP-1175E	1	This manual

The Role of This Manual
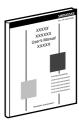
Two manuals are available for the AUR350C. Read them as necessary for your specific requirements. If a manual you require is not available, contact Yamatake Corporation or its dealer.

AUD300C Advanced UV Sensor　　　　　**Manual No. CP-SP-1141E**

Explains how to mount the AUD300C as part of a combustion system, as well as its wiring, maintenance, inspection, and troubleshooting.

AUR350C Advanced UV Relay with Communications
　　　　　　　　　　　　　　　　　　Manual No. CP-SP-1175E

This manual.
Personnel in charge of design, mounting, operation, and maintenance of combustion equipment using the AUR350C should read this manual.
It describes the mounting, wiring, trial-run adjustment, maintenance, inspection of the AUR350C.

Contents

Chapter 5. CONFIGURATION AND DATA READING

Chapter 6. COMMUNICATIONS FUNCTIONS

Chapter 7. MAINTENANCE AND INSPECTION

Chapter 8. SPECIFICATIONS

Conventions Used in This Manual

The following conventions are used in this manual:

⚠ **Handling Precautions**:
Handling Precautions indicate items that the user should pay attention to when handling the AUR350C.

📖 **Note**:
Notes indicate information that might benefit the user.

☞:
This indicates the item or page that the user is requested to refer to.

(1), (2), (3):
Numbers within parentheses indicate steps in a sequence or parts of an explanation.

>>:
Indicates the result of an operation, details displayed on the personal computer or other devices, or the state of the device after operation.

Chapter 1. OVERVIEW

■ **Overview**

The AUR350C Advanced UV Relay with Communications is a safe combustion controller with a dynamic self-checking function, used in combination with the AUD300C Advanced UV Sensor.

By driving the shutter of the AUD300C, the AUR300C checks itself and the AUD300C for faulty operation while driving the flame relay.

If a fault occurs in the flame detection circuit of the AUD300C or AUR350C, the AUR350C turns OFF the relay to ensure operational safety. Since the AUR350C tracks data on flame voltage, shutter on-off cycles, etc., flame voltage trends can be viewed on a PC monitor.
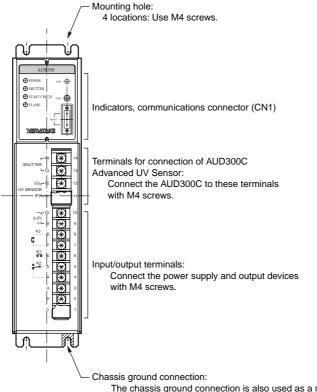
■ **Features**

- One AUR350C monitors one burner.

- The dynamic self-checking function continuously checks the flame detection circuits of the AUD300C and AUR350C to ensure operational safety.

- If a fault occurs in the flame amplifier of the AUD300C or AUR350C during combustion, the main valve and pilot valve are shutoff. If a fault is found during the start-up operation, the check relay is not turned ON and there is no output (flame output) to the main valve.

- Operation status can be checked using various LED indicators (POWER, SHUTTER, START CHECK, and FLAME).

- A flame signal output (0 to 5Vdc) is provided as a standard function. This is useful for burner adjustment and flame status control.

- PC software (the Smart Loader Package) that is used for various configuration tasks on the AUR350C is available.

- By means of the Smart Loader, the K3 relay can be configured to operate in various ways (upon event occurrence, synchronized with K1/K2, if flame voltage upper limit/lower limit is exceeded, for inspection period notification, etc.).

- The AUR350C can display trend monitoring data (flame voltage, shutter on-off cycles, K1/K2/K3 operation), maintenance data and playback data (history of event occurrence) on a PC through RS-485 communications.

📖 **Note**

- In the AUR350C system, false flame, false discharge, short circuit between terminals F and G, flame voltage drop, etc. are categorized as events. Factory settings have been made in advance for various options. Be sure to check them.

■ Part names

Mounting hole:
    4 locations: Use M4 screws.

Indicators, communications connector (CN1)

Terminals for connection of AUD300C
Advanced UV Sensor:
    Connect the AUD300C to these terminals
    with M4 screws.

Input/output terminals:
    Connect the power supply and output devices
    with M4 screws.

Chassis ground connection:
    The chassis ground connection is also used as a mounting hole.
    The paint is scratched off to make a good electrical connection.

● Terminal pin assignments
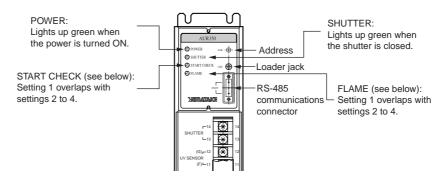
Terminal No.	Description	Electrical rating
14	Advanced UV sensor shutter (white)	24Vdc 150mA (*1)
13	Advanced UV sensor shutter (white)	
12	Advanced UV sensor terminal G (yellow)	—
11	Advanced UV sensor terminal F (blue)	
10	Flame voltage output (−)	0 to 5Vdc (*2)
9	Flame voltage output (+)	
8	K3 relay output	3A 250V (cos φ =1)(*3)
7	K3 relay output	
6	Flame output (K1, K2)	5A 250V (cos φ =1)
5	Common contact output	—
4	K2 relay (NC flame relay)	5A 250V (cos φ =1)
3	Start input	—
2	Power supply (R) high voltage side	100/200Vac 50/60Hz
1	Power supply (S) ground side	

*1: The shutter has no polarity.

*2: Always use a measuring instrument having an input impedance of 100 kΩ or more. Additionally, when connecting any measuring instrument to these terminals, use an IV lead wire with a size of 0.75mm^2 or more and a length of 10m or less.

*3: For the K3 relay, various event outputs upon the occurrence of an abnormality can be selected using the Smart Loader. The factory setting is 3, meaning that output is ON upon event occurrence. When the factory setting for event contents is 2, the K2 relay is OFF (false discharge).

For details, refer to:
☞ Chapter 5, "Configuration And Data Reading."

● **Indicator details**

POWER:
Lights up green when
the power is turned ON.

START CHECK (see below):
Setting 1 overlaps with
settings 2 to 4.

SHUTTER:
Lights up green when
the shutter is closed.

FLAME (see below):
Setting 1 overlaps with
settings 2 to 4.

Address

Loader jack

RS-485
communications
connector

START CHECK LED operation and display

Setting	Name	Stage of operation	Color	Description
1	Synchronized with K1 relay	Upon start/stop	Green	ON/OFF synchronized with K1 relay ON/OFF.
2	Event occurrence	Upon start/stop	Red	Blinks upon event occurrence (one second cycling)
3	Inspection frequency 1	Upon stop	Red	Blinks red for inspection period 1. Blinks upon stop (with K1 and K2 OFF).
4	Inspection frequency 2	Upon stop	Red	Blinks red for inspection period 2. Blinks upon stop (with K1 and K2 OFF).

• The initial setting is 2. (Setting 1 is always active even when setting 2, 3 or 4 is selected.)

• Operation status: During operation: The K1 (start check) and K2 (flame) relays are ON.

While stopped: K1 and K2 relays are OFF.

• If notifications of an event occurrence and inspection period are both activated at the same time, the event has priority.

• If an event (normally a red blink) occurs when the K1 relay is ON (indicated by a green light), the result is alternating green and orange blinks.

FLAME LED operation and display

Setting	Name	Stage of operation	Color	Description
1	Synchronized with K2 relay	False flame / during operation	Green	ON/OFF synchronized with K1 relay ON/OFF. If the flame voltage level has been set, the color of the light changes.
2	Flame voltage level	When the K2 relay is energized (false flame / during operation)	Green Orange Red	The color of the light changes according to the flame voltage level. Green: 2.5Vdc or more Orange: 1.5 ≤ voltage < 2.5Vdc Red: less than 1.5Vdc The LED goes out upon K2 OFF.
3	Inspection frequency 3	Upon stop	Red	Blinks red for inspection period 3. Blinks upon stop (with K1 and K2 OFF).
4	Inspection frequency 4	Upon stop	Red	Blinks red for inspection period 4. Blinks upon stop (with K1 and K2 OFF).

The initial setting is 2. (Setting 1 is always active even when setting 2, 3 or 4 is selected.)

● **Switch layout and function**

Upper peg

⇧ Top

AUR350

POWER
SHUTTER
START CHECK
FLAME

Faceplate sheet

Lower peg

SHUTTER ┌14 / 14
        └13 / 13
(G) ┌12 / 12
UV SENSOR
(F) └11 / 11

The AUR350C has a station address switch and reset switch for communications. These switches are located behind the faceplate of the AUR350C display area. When setting a station address or resetting events, pull the upper portion of the faceplate toward you in order to remove it from the upper peg, and then slide the faceplate upward.

Switch layout

S3: Reset switch. This switch is used in combination with the reset selection switch (S2) to clear the current frequency value to 0 and also to reset an event upon event occurrence. The switch initializes the contents selected from the table below. When all S2 DIP switches are OFF, S3 resets an event.

S2: Reset selection switch. This DIP switch is used to select a reset type.

POWER
SHUTTER
START CHECK
FLAME

S1: Rotary switch for station address. The RS-485 communication address switch is selectable from 0 to F (15). This switch is always valid after power ON. If the station address is set at 0, communication is not possible.

Loader jack

RS-485 communications

S2 operation

Setting	Description
1	When the reset switch (S3) is turned ON, the current value of inspection frequency 1 is reset to 0.
2	When the reset switch (S3) is turned ON, the current value of inspection frequency 2 is reset to 0.
3	When the reset switch (S3) is turned ON, the current value of inspection frequency 3 is reset to 0.
4	When the reset switch (S3) is turned ON, the current value of inspection frequency 4 is reset to 0.

■ Model No. key

Series	Basic No.	Function	Flame response	Power supply	Additional processing	Description
AUR						Advanced UV relay
	350C					With communications function
		1				Fixed
			2			Flame response nominal 1.5s
			3			Flame response nominal 3s
				1		100Vac
				2		200Vac
					00	No additional processing
					D0	Inspection certificate provided
					T0	Tropicalization treatment applied

■ Configuration

● Corresponding flame detector

Name	Model No.
Advanced UV sensor	AUD300C

● Optional parts

Name	Model No.
Flame simulator	123514B
Lightning surge absorber	83968019-001
Loader cable	81440793-001
Communications connector	81446848-001 (1 piece)

Chapter 2. MOUNTING AND WIRING

2 - 1　　　Mounting

⚠ CAUTION

🚫
Do not mount the AUR350C in the following places:
- In the presence of chemicals or corrosive gas, such as ammonia, sulfur, chlorine, ethylene compound, acid, or others.
- Where it is exposed to water drops or damp atmosphere.
- Where it is exposed to high temperatures.
- Where vibration continues for an extended period of time.

❗
Only authorized personnel who have technical skills with combustion equipment and flame safeguard control should carry out the pilot turndown test.

● **Mounting position**

Mount the AUR350C on a panel.
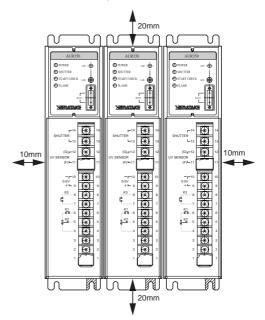When mounting the AUR350C vertically, it is possible to gang-mount the unit.
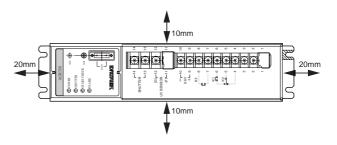
● **Mounting procedures**

(1) To allow easy removal, heat radiation, wiring, and maintenance work, keep a work space that is 20mm or more in the vertical direction and 10mm or more in the horizontal direction as shown in the Figure below.

Vertical mounting
(It is possible to gang-mount the AUR350C.)

Horizontal mounting

(2) Use the drawing below as a guide for making holes in the panel.

Vertical mounting   Horizontal mounting

Mounting Dimensions

(3) Secure the AUR350C to the mounting holes (four locations) with M4 screws.

⚠ **Handling Precautions**

• Paint is scratched off the lower right mounting hole of the AUR350C to ensure a good electrical connection. This hole is used as the chassis ground connection. Use a toothed lock washer for a good electrical connection.

• When mounting the AUR350C horizontally, it is not possible to use gang-mounting.

2 - 2   Wiring

⚠WARNING

Before wiring the AUR350C, be sure to turn the power OFF. Failure to do so might cause electric shock.
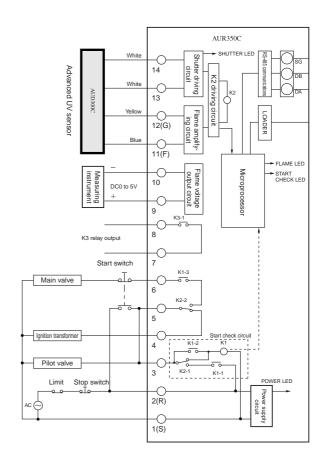
⚠CAUTION

Carefully perform the mounting and/or wiring work while referring to this user's manual, as well as the instruction manuals published by the equipment manufacturers.

Check the insulation of each wire. Faulty insulation may cause a ground fault or an electric shock.

Carry out the wiring work in conformity with the specified standards.

Always connect the power supply last. Otherwise, touching a terminal accidentally may cause electric shock or damage.

The load connected to each terminal must not exceed the rating shown in the specifications.

Always supply electric power with the voltage and frequency stated on the model label of the AUR350C.

If timers and auxiliary relays are needed to for additional functions, always select those with high reliability and be sure to design the circuit correctly.

The AUR350C must be grounded with a resistance of less than 100Ω, as described in technical standards for electrical equipment. The ground wire must be connected to the burner chassis.

The power cable and high-voltage cable of the ignition transformer must be separated from the power cable of the AUD300C.

The high-voltage cable of the ignition transformer must be separate and kept 10 cm or more away from the AUR350C.

Connect the high-voltage cable of the ignition transformer securely so that there is no faulty contact. A faulty connection will produce high-frequency radio waves, causing radio interference or malfunction. Additionally, mount the ignition transformer directly on the burner main unit or on a metallic part electrically connected to the burner main unit.

After the wiring has been done, always check that it is correct. Incorrect wiring may cause damage or malfunction.

■ Wiring diagram
● Monitoring of burner flame
● Manual ignition (intermittent pilot)
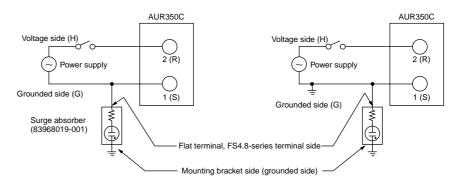
⚠ Handling Precautions

- If the high voltage side (H) of the power supply is distinguished from the grounded side (G), connect the high voltage side (H) to terminal 2 (R) and the grounded side (G) to terminal 1 (S).

- For wiring to the power source, use a 0.75mm^2 wire (0.18mm dia., 30 cores) in keeping with JIS C3306.

- Connect an FS4.8 series flat connection terminal (equivalent to a #187 series receptacle made by AMP) to the end of the cable, and then do the wiring, keeping the wire as short as possible.

- Playback data may be erased if equipment operation stops for more than 4 hours.

● **Connecting with surge absorber**

When using the optional surge absorber (model 83968019-001) as a protective measure against lightning, connect it as shown below.
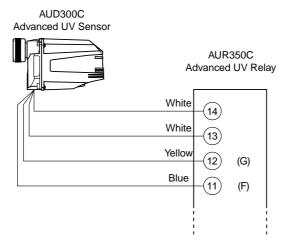
⚠ Handling Precautions

- Connect the flat connector FS4.8 series (AMP's #187 series receptacle or equivalent) to one end of the electric cable and make the wiring as short as possible.

- The grounded side of the metallic bracket for mounting of the surge absorber is crimped internally so it makes good electrical contact. Mount this bracket on a metallic part such as the burner chassis to connect the ground wire.

■ Connection to the AUD300C

Wire the AUD300C as shown below.

⚠ Handling Precautions

- The signal wires of the AUD300C (blue and yellow) have specific polarities. Connect the blue wire to terminal 11 (F) of the AUR350C and the yellow wire to terminal 12 (G).

  Reversing the signal wires may cause the tube unit to break or malfunction.

- To extend the wiring, use 2mm^2 600V-vinyl insulated IV cable with a length of 200m or less.
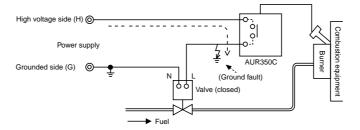
■ **Wiring to solenoid valve**

⚠ **WARNING**
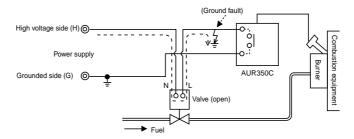
🚫 Do not connect the solenoid valve to the high voltage side. If a ground fault occurs, the ground fault current may flow into the solenoid valve. The AUR350C, will not be able to prerent the valve from opening and fuel from flowing out.

● **Correct connection**

When the valve wiring is connected correctly as shown in the figure above, current does not flow through the solenoid valve even if a ground fault occurs due to faulty insulation on the high voltage side. Therefore, the valve does not open and fuel does not flow out.

● **Incorrect connection**
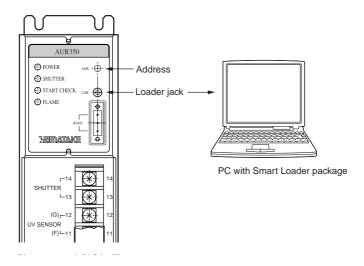
If the valve wiring is connected to the high voltage side, current flows through the solenoid valve if a ground fault occurs, as shown in the figure above. Therefore, the valve opens in spite of the AUD350C and fuel flows out.

■ **Cautions for continuous measurement of flame voltage**

• Connect a measuring instrument to the AUR350C having an input impedance of 100kΩ or more and connect a pen recorder having an input impedance of 1MΩ or more.

• Always use an IV cable with a size of 0.75 mm^2 or more for signal lines. The wiring length must be 10m or less.

2 - 3   Communications Connection
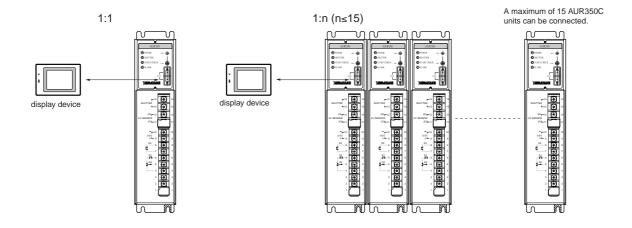
■ Communications with the Smart Loader

PC with Smart Loader package

⚠ Handling Precautions

- Transmission distance is 10m or less.
- Connect using a modular jack.

■ Connection to display devices

1:1

1:n (n≤15)

A maximum of 15 AUR350C units can be connected.

display device

display device

📖 Note

- For the 1:n connection examples, refer to the instructions for 3-wire and 5-wire system connections (page 14).

1:1

AUR350C connection with display device

AUR350C   EST display device

5-wire system

3-wire system

■ RS-485 communications

Signal level	RS-485-compliant
Transmission line connection	Multipoint
Synchronous method	Start-stop synchronization
Transmission control	Polling/selecting method
Maximum length of extension cable	Max. 500m
Transmission speed error	Max. 0.16%
Transmission speed	19200bps
Data length	8 bits
Stop bit length	1 bit
Parity	Even
Error detection	Vertical redundancy check

● Communications connection

Using the RS-485 communication ports (DA, DB, SG), up to 15 units can be connected.

(3-wire system)

Master station		AUR350C (CN1 pins 1-3)
DA+	→	DA
DB-	→	DB
SG	→	SG
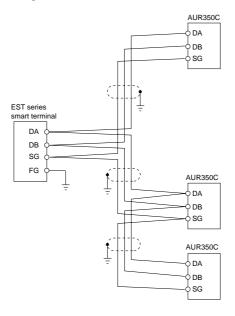
● Communications settings

Station address is set by rotary switch (S1).
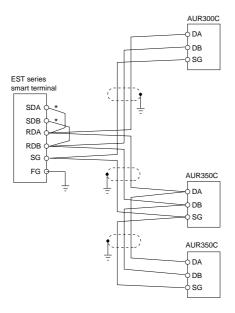
The items shown in the table below can be set with the Smart Loader. (Settings take effect after power is restarted.)

Item	Description	Initial value
Data format	Data length 8 bits, even parity, 1 stop bit or 8 bits, no parity, 2 stop bits	8 bits, even parity, 1 stop bit
Transmission speed	19200/9600/4800/2400bps	19200bps
Minimum response time	1/10/100/200ms	10ms

■ **Connection with a 3-wire system**

■ **Connection with a 5-wire system**
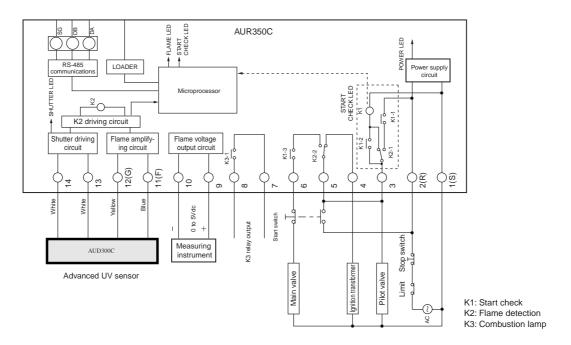
⚠ **Handling Precautions**

- Do not connect terminating resistors on communications circuits.

- Ground shielded wire to one point on one side of the cable.

- Wire the connections marked with an asterisk (*) externally, when five RS-485 terminals are used.

- Use a twisted shielded pair cable for RS-485 communications.

- Be sure to connect the SG terminals together. Failure to do so might cause unstable communications.

Chapter 3. OPERATION
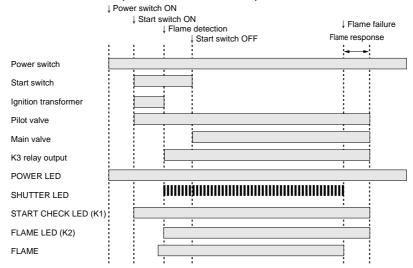
Manual ignition method (intermittent pilot)
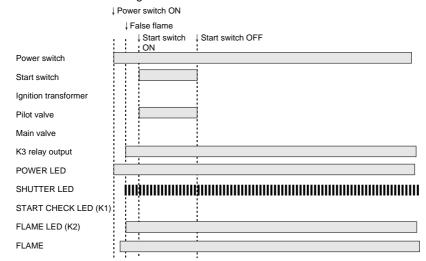
Switch and controller	AUR350C operation	POWER LED	SHUTTER LED	START CHECK LED	FLAME LED
Power ON Limit ON	• Power is applied to terminals 1 (S) and and 2 (R). (Power is applied to the AUR350C relay.)	●	○	○	○
Start switch ON	• When power is applied to terminal 3, the K1 relay is turned ON through the K2-1 flame relay contact (if closed: false flame check)	●	○	●	○
	• When the pilot flame is detected, the flame relay (K2) is turned ON. The output of the pilot valve continues while the K1 relay is ON and contacts K1-1 and K1-2 are closed.	●	◎	●	●
	• When K2-2 and K1-3 close, the main valve enters the stand-by mode.	●	◎	●	●
	• When K3-1 closes, the combustion lamp lights up.	●	◎	●	●
Start switch OFF	• When power is applied from terminal 3 to terminals 5 and 6, the main valve is operated.	●	◎	●	●
Stop operation: stop sw. OFF	• All relays are turned OFF.	○	○	○	○
Flame shutoff during operation	• All relays are turned OFF.	●	○	○	○

●: Lit, ○: Off, ◎: Flashing
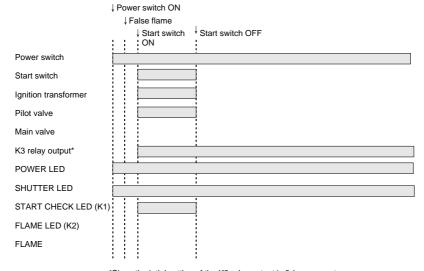
● Transition from normal operation to flame shutoff operation

↓ Power switch ON
↓ Start switch ON
↓ Flame detection
↓ Start switch OFF
↓ Flame failure
Flame response

Power switch
Start switch
Ignition transformer
Pilot valve
Main valve
K3 relay output
POWER LED
SHUTTER LED
START CHECK LED (K1)
FLAME LED (K2)
FLAME

● False flame exists before ignition

↓ Power switch ON
↓ False flame
↓ Start switch ON
↓ Start switch OFF

Power switch
Start switch
Ignition transformer
Pilot valve
Main valve
K3 relay output
POWER LED
SHUTTER LED
START CHECK LED (K1)
FLAME LED (K2)
FLAME

● Flame signal exists while the shutter is closing

↓ Power switch ON
↓ False flame
↓ Start switch ON
↓ Start switch OFF

Power switch
Start switch
Ignition transformer
Pilot valve
Main valve
K3 relay output*
POWER LED
SHUTTER LED
START CHECK LED (K1)
FLAME LED (K2)
FLAME

*Since the intial setting of the K3 relay output is 3 (upon event occurrence), K3 relay output is ON.

Chapter 4.   TRIAL-RUN ADJUSTMENT

⚠ WARNING
❗ The pilot and main burner ignition time must not exceed the ignition time specified by the burner or equipment manufacturer. If they do, fuel may accumulate in the combustion chamber to form an explosive mixture, causing a serious explosion hazard.
🚫✋ Never touch any terminal of the AUR350C during trial-run adjustment. Doing so may cause an electric shock.
❗ Before removing or mounting the AUR350C, be sure to turn the power OFF. Failure to do so may cause an electric shock.
❗ Before starting the pilot turndown test or ignition spark response test, always check that all manual fuel valves are closed.
🚫 Do not begin actual operation until the trial-run adjustment tests and tests specified by the equipment manufacturer are completed.
🚫✋ Never touch terminal 11 (F) immediately after the power has been turned OFF. Terminal 11 (F) is electrically alive for 1 minute after the power to the AUR350C has been turned OFF. Touching it may cause an electric shock.

■ Outline of adjustment

The following shows the test adjustment items described in this chapter:

- Measurement of flame voltage

- Pilot turndown test

- Ignition spark response test

- Safety shutoff test

⚠ **Handling Precautions**

- After the above items have been adjusted, check again that each adjustment is satisfactory. It is absolutely necessary for all adjustments to be correct before the final positioning of the flame detector.

● Tools and parts needed

- Multimeter: Input impedance: 100kΩ or more

    AC range: 0 to 300V

    DC range: 0 to 10V

- Jumper cables with clips (2)

■ Preliminary inspection

(1) Inspect all wiring parts.

(2) Check that the AUR350C is mounted in a place where the ambient temperature is within its allowable range.

(3) Check that the AUD300C is mounted correctly. In particular, be sure the blue lead wire (to terminal 11) and yellow lead wire (to terminal 12) of the AUD300C are connected correctly. For details, refer to the user's manual for the AUD300C, No. CP-SP-1141E.

(4) Check that the valves and cocks of each fuel system are closed and that the inside of the fuel chamber is vented sufficiently.

(5) After items 1 to 4 above have been checked, supply the power and start the trial-run adjustment.

■ Measurement of flame voltage (flame signal)

Start the equipment and measure the voltage under several conditions, such as start-up operation and normal operation.

(1) Set the multimeter to the 0 to 10Vdc range.

(2) Connect the + (positive) probe of the multimeter to terminal 9 and the - (negative) probe to terminal 10.

(3) Check that the voltage is stable at a recommended flame voltage of 2.0 to 4.0V for the 1.5s flame response time type and 1.5 to 4.0V for the 3s flame response time type.

(4) If the flame voltage fluctuates widely, check the AUD300C's mounting position, wiring, and the line.

⚠ Handling Precautions

- Even during normal operation, the flame voltage is synchronized with the shutter operation of the AUD300C and fluctuates in a range of 0.1 to 0.3V.

■ Pilot turndown test

This test is intended to check that the flame is reliably transferred to the main burner when the AUD300C detects a pilot flame if the gas pressure and air pressure are changed to their worst conditions.

⚠ WARNING

❗	If the AUD300C detects a pilot flame that is too small to ignite the main burner, the AUR350C will not recognize a flame failure in the main burner. In this case fuel would flow out continuously, causing a serious explosion hazard. To prevent such an occurrence, always perform the pilot turndown test carefully.
❗	When performing the pilot turndown test repeatedly, stop the equipment completely every time the pilot turndown test is completed in order to vent the unburnt gas or oil that has accumulated in the combustion chamber or flue completely. If unburnt gas or oil is not purged completely, an explosion may occur.
❗	After the pilot turndown test has been completed, turn OFF the power switch to shutdown the power. Restore all test jumpers and limit/regulator settings to their previous states. If operation begins without the above steps, damage to the equipment, gas leak or explosion may result.

⚠ CAUTION

❗	Only authorized personnel who have technical skills with combustion equipment and flame safeguard control should carry out the pilot turndown test.

⊡ Handling Precautions

- If a fuel pressure limit switch is used, and its contacts are open, turn it ON with a jumper cable during this test.

To carry out the pilot turndown test, follow the steps below.

● **Preparations before test**

(1) Turn OFF the power switch.

(2) Close the manual valves to stop the gas supply to the pilot burner and main burner.

(3) Open the manual valve for the pilot burner.

● **Check a gas pressure level, at which the AUD300C cannot detect the pilot flame.**

(4) Turn ON the power switch and press and hold the start switch.

>> The ignition operation begins, the pilot valve opens, and the ignition transformer is activated. The flame relay turns ON and the combustion lamp lights up.

(5) Close the manual valve for the pilot burner slowly.
The pilot flame gradually becomes smaller. Gradually close the valve until the AUD300C cannot detect the flame.

(6) Record the gas pressure immediately before the flame relay turns OFF and the combustion lamp goes off. Release the start switch.

● **Check that the main burner can be ignited with the minimum pilot flame.**

(7) Press and hold the start switch again.

(8) Open the manual valve for the pilot slowly to adjust the pressure to a level immediately before the combustion lamp goes off. Check that the flame relay is turned ON and that the combustion lamp is lit up.

(9) Release the start switch.

(10) Check that the main burner is ignited smoothly within 1 second after the manual valve for the main burner has opened.

(11) Change the gas pressure level between the minimum and maximum levels and ignite the main burner five or six times. Be sure that the main burner ignites smoothly every time.

● **If the main burner does not ignite with the minimum pilot flame.**

(12) Adjust the mounting position of the AUD300C and the amount of incoming light so that the AUD300C cannot detect a pilot flame that cannnot ignite the main burner.
There are two kinds of adjustment procedures.
• Move the monitoring area of the sighting pipe slightly away from the pilot flame.
• Narrow the sighting pipe to decrease the incoming light amount from the pilot flame.

(13) Open the manual valve for the pilot burner slowly to make the pilot flame larger than the previous flame.

● **After adjustment, check again that the main burner can be ignited with the minimum pilot flame.**

(14) Perform steps 7-11 ("Check that the main burner can be ignited with the minimum pilot flame") again.

● **Measures to be taken after completion of the test**

(15) After the test has been completed, return the manual valve of the main burner to its fully open position.

(16) Check that the flame voltage is correct.

(17) If any limit switch has jumper cables attached, disconnect them to return the limit switch to its previous state.

■ **Ignition spark response test**

⚠ **WARNING**
Be sure the AUD300C does not detect ultraviolet rays other than those of the burner flame. If the AUD300C responds to other ultraviolet rays, flame failure in the burner will go unnoticed, allowing fuel to flow continuously, causing a serious explosion hazard.

(1) Close the manual fuel valves of the pilot and main burners.

(2) Begin operation and measure the flame voltage in the pilot ignition sequence to check whether or not the flame voltage is influenced.

(3) If the FLAME LED is lit, make adjustments using the following procedures while referring to the instruction manual for the equipment:

- Move the AUD300C or ignition spark rod so that there is no influence.

- Put a shielding plate in the optical path of the AUD300C so that the effect of the spark is a flame signal of 0.4Vdc or less.

⚠ Handling Precautions

- Be sure the AUR350C does not detect ultraviolet rays other that those of the burner flame.

- The following shows various ultraviolet ray sources other than the burner flame that may activate the AUD300C:

Ultraviolet ray source	Red-hot furnace wall (within 50 cm of furnace wall)
	Ignition transformer and welding arc
	Gas laser
	Sunlamp
	Disinfecting lamp, ultraviolet lamp, fluorescent lamp
	Strong flashlight (toward UV sensor)
Gamma ray and X ray source	Regression analyzer
	Electron microscope
	X-ray camera
	High voltage vacuum switch
	High voltage capacitor
	Radioisotope
	Other sources producing ultraviolet rays, gamma rays, and X-rays

■ Safety shut-off test

After all operational adjustments have been completed, carry out the safety shutoff test.

● Pilot ignition failure (ignition failure)

(1) Close the pilot and main manual fuel valves.

(2) Press the start switch.

\>> Operation begins.

(3) Normally, at pilot burner ignition, the pilot valve opens. Check that the FLAME LED does not light up and that the main valve does not open if the flame fails.

● Flame failure during normal combustion

(1) Open the pilot and main manual fuel valves.

(2) Press the start switch to begin operation.

(3) When the sequence has progressed correctly and normal combustion has begun (main valve has opened), close the pilot and main manual fuel valves to put out the burner flame. Then, check that flame failure is detected and that safety shutoff is correctly activated.

Chapter 5.   CONFIGURATION AND DATA READING

■ K3 relay output (set by the Smart Loader)

The K3 relay's mode of operation can be selected, as shown in the table below.

● Selection of K3 relay operation

Setting	Name	K3 relay operation
1	Synchronized with K1	Operates in the same way as the K1 relay.
2	Synchronized with K2	Operates in the same way as the K2 relay.
3	Upon event occurrence	ON when an event occurs. (Refer to; Event selection and resetting.)
4	Flame voltage upper limit	ON when flame voltage exceeds the value set as the upper limit. The flame voltage upper limit is set with the Smart Loader.
5	Flame voltage lower limit	ON when flame voltage drops below the value set as the flame voltage lower limit. The flame voltage lower limit is set with the Smart Loader.
6	Inspection frequency 1	ON when inspection frequency 1 is set. (Refer to; Inspection frequency setting and resetting.)
7	Inspection frequency 2	ON when inspection frequency 2 is set. (Refer to; Inspection frequency setting and resetting.)
8	Inspection frequency 3	ON when inspection frequency 3 is set. (Refer to; Inspection frequency setting and resetting.)
9	Inspection frequency 4	ON when inspection frequency 4 is set. (Refer to; Inspection frequency setting and resetting.)
10	Communications command	ON when writing to communication address 3900W through RS-485.

Initial setting: 3. (Multiple selections are possible.)

⚠ Handling Precautions

- If there are multiple event selections, K3 is energized when one of the operating conditions is satisfied, and de-energized when none of the operating conditions are satisfied.

📖 Note

- Selection 3: Upon event occurrence

  This provides information about the operation of the flame detector or the status of burner flame detection. A history of the past 8 occurrences of an event can be stored in nonvolatile memory.

- Selections 4 - 5: Flame voltage upper/lower limit

  The flame voltage upper limit and lower limit can be used as a sort of meter relay. The upper and lower limits can be used to regularly check the flame voltage. The flame voltage may vary depending on various factors, such as air-fuel ratio, fuel pressure, deterioration of the burner, and/or deterioration of the flame sensor. Because the frequency of burner operation can be checked by flame voltage limit data, the data can be utilized to determine how often maintenance is needed.

- Selections 6 - 9: Inspection frequencies 1 to 4

  The frequency of a notification that an inspection is due depends on the operation time or operation cycles of the burner. These selections are used as a substitute for a counter and cumulative timer. Additionally, it is possible to call up actual values through RS-485 communications or to learn that an inspection is due from the LED display.

● **Sub-settings related to the K3 relay operation selection (set by the Smart Loader)**

Sub-setting	Description	Initial value	Remarks
ON delay time	The delay before K3 relay ON (0.1 to 5.0 seconds)	1.0s	
OFF delay time	The delay before K3 relay OFF (0.1 to 5.0 seconds)	1.0s	
Flame voltage upper limit value	The flame voltage upper limit (0 to 5.0Vdc)	4.0V	Recommended flame voltage is 1.5 to 4.0Vdc.
Flame voltage lower limit value	The flame voltage lower limit (0 to 5.0Vdc)	1.5V	

⚠ Handling Precautions

- Use the K3 relay output for monitoring or prediction. Do not use the K3 relay output as a burner shutoff signal, because if the K3 relay output is used for burner shutoff, burner combustion may be stopped even during normal operation.

- Use the data read through communications for monitoring only. Do not use it for purposes of control.

■ LED display

The function of the LED indicators (START CHECK LED / FLAME LED) can be selected, as shown in the table below. Multiple selections are possible, in which case a logical OR operation of the selected items is performed.

● START CHECK LED operation and display

Setting	Name	Stage of operation	Color	Description
1	Synchronized with K1 relay	Upon start/stop	Green	ON/OFF synchronized with K1 relay ON/OFF
2	Upon event occurrence	Upon start/stop	Red	Blinks upon event occurrence (one second cycling)
3	Inspection frequency 1	Upon stop	Red	Blinks red for inspection period 1. Blinks upon stop (with K1 and K2 OFF).
4	Inspection frequency 2	Upon stop	Red	Blinks red for inspection period 2. Blinks upon stop (with K1 and K2 OFF).

• The initial setting is 2. (Setting 1 is always active even when setting 2, 3 or 4 is selected.)
• Operation status: During operation: the K1 (start check) and K2 (flame) relays are ON.
    While stopped: the K1 and K2 relays are OFF.
• If notifications of an event occurrence and inspection period are both activated at the same time, the event has priority.
• If an event (normally a red blink) occurs when the K1 relay is ON (indicated by a green light), the result is alternating green and orange blinks.

● FLAME LED operation and display

Setting	Name	Stage of operation	Color	Description
1	Synchronized with K2 relay	False flame / during operation	Green	ON/OFF synchronized with K2 relay ON/OFF. If the flame voltage level has been set, the color of the light changes.
2	Flame voltage level	When the K2 relay is energized (false flame / during operation)	Green Orange Red	The color of the light changes according to the flame voltage level. Green: 2.5Vdc or more Orange: $1.5 \leq$ voltage < 2.5Vdc Red: less than 1.5Vdc The LED goes out upon K2 OFF.
3	Inspection frequency 3	Upon stop	Red	Blinks red for inspection period 3. Blinks upon stop (with K1 and K2 OFF).
4	Inspection frequency 4	Upon stop	Red	Blinks red for inspection period 4. Blinks upon stop (with K1 and K2 OFF).

• The initial setting is 2. (Setting 1 is always active even when setting 2, 3 or 4 is selected.)

■ Inspection frequency setting and resetting (using the Smart Loader)

The AUR350C accumulates and stores data about operation time (when current is continuously applied), combustion time, and/or number of combustion ON times, depending upon the user's selections. The frequency of each inspection can be set on the basis of this data.

● Inspection frequency settings

Item	Operation		Inspection interval settings	
	Selection	Intial setting	Range	Intial setting
Inspection frequency 1	0: None 1: Operation time 2: Combustion time 3: No. of combustion starts	0: None	— 0–99,999 hrs. 0–99,999 hrs. 0–99,999 times	— 25,000 hrs. 20,000 hrs. 10,000 times
Inspection frequency 2	0: None 1: Operation time 2: Combustion time 3: No. of combustion starts	0: None	— 0–99,999 hrs. 0–99,999 hrs. 0–99,999 times	— 25,000 hrs. 20,000 hrs. 10,000 times
Inspection frequency 3	0: None 1: Operation time 2: Combustion time 3: No. of combustion starts	0: None	— 0–99,999 hrs. 0–99,999 hrs. 0–99,999 times	— 25,000 hrs. 20,000 hrs. 10,000 times
Inspection frequency 4	0: None 1: Operation time 2: Combustion time 3: No. of combustion starts	0: None	— 0–99,999 hrs. 0–99,999 hrs. 0–99,999 times	— 25,000 hrs. 20,000 hrs. 10,000 times

● Inspection frequency resettings

To reset an inspection frequency to 0, do as follows:

By switch: Use the S2 reset selection switch and the S3 reset switch on the display unit of the AUR350C (see page 4).

Communication: Write "0" to the appropriate RS-485 communication address, 1121 to 1128W (see the address map on page 47). Alternatively, use the Smart Loader (refer to manual CP-UM-5319E).

📖 Note

• Whether or not the operation time, combustion time, and the number of combustion starts exceeds those stated in inspection frequencies 1 to 4, the user can check on inspection notification occurrence status using RS-485 communications address 1120W.

■ Event contents selection and resetting (using the Smart Loader)

An event provides information about the operation of the flame detector or the status of burner flame detection. When an event occurs, it is indicated by K3 relay output or by LED. Additionally, a history of the past 8 occurrences of an event can be stored in nonvolatile memory. (Unselected events are not stored.)

● Event contents selection

Setting	Name	Reset method	Description
1	False flame	Automatic or by resupplying power	K2 (the flame relay) is ON before start, and K1 (the start check relay) is not activated. The cause might be a false flame or contact welding of K2.
2	K2 relay OFF (while shutter is closed), false discharge	Switch, communications, restart, resupplying power	The shutter is closed when K2 is OFF (flameout). The cause might be a shutter failure, tube unit failure or the failure of the flame detection circuit of the AUR350C. (A flame is detected even though the shutter is closed: the tube unit or flame detection circuit detects a flame in the shutter-closed state.)
3	Shutter-closed time increases during operation	Switch, communications, restart, resupplying power	This is an alarm output for maintenance when the shutter-closed time becomes longer during operation (with K1 and K2 relays both ON). If the AUR350C is not working properly, the shutter closing time becomes longer. Probable causes: • The UV tube has deteriorated and has begun to self-discharge. • Shutter malfunction • Shutter cannot close off the light because of diffused reflection due to overly strong ultraviolet rays. The shutter is normally closed for approximately 0.5 to 0.7 seconds (at a 3.5Vdc flame voltage).
4	F-G short circuit	Automatic, power resupply	The F and G wires of the AUD are short-circuited.
5	Flame voltage decrease	Automatic, switch, communications, restart, resupplying power	The flame voltage decreases during operation (with K1 and K2 both ON). This is an alarm output for maintenance. The check starts 15 seconds after K2 is energized and continues until 4 seconds before K2 is de-energized, and then the flame voltages are compared. This is to catch a flame voltage drop caused by dirt or deterioration of the tube unit or a change in the burner combustion state during a long period of operation.
6	K2 relay OFF (while shutter is open)	Automatic, switch, communications, restart, resupplying power	K2 is de-energized during operation, and no flame is detected even though the shutter is open.

The initial setting is 2. (Multiple selections are possible.)

🛈 Handling Precautions

• Setting 6, K2 relay OFF (while shutter is open)
The AUR350C cannot tell whether a decrease of flame voltage is because the flame has gone out or because the burner has been shut down. Since history data is overwritten if many shutdowns occur, care must be taken in use. If few shutdowns occur, or if the power is turned OFF to stop combustion, this event setting can be used for flame failure.

● **Sub-settings related to event contents selection (set by the Smart Loader)**

Sub-settings	Range	Intial value	Description
Shutter-closed time	0.1 to 5.0s	3.0s	Shutter-closed time threshold value (setting 3)
Time between decrease and recovery of flame voltage	0.1 to 5.0s	1.0s	The time to continue below the value set for flame voltage decrease (setting 5).
Flame voltage decrease set value	0 to 5.0V	1.5V	Setting 5

● **Resetting events**

Automatic: When the equipment returns to normal status, events are automatically cancelled and reset. The flame voltage decrease event is cancelled when the current flame voltage exceeds the set value + 0.1V for longer than the value set as the time between decrease and recovery of flame voltage.

Restart: Events can be reset when K1 is energized from the stop state.

Resupplying power: Events can be reset after power is resupplied.

Switch: Events can be reset by pressing the S3 switch after turning OFF all DIP switches (4 points) of switch S2 on the display area of the AUR350C.

Communications: Events can be reset by writing to RS-485 communications address 3805W (see the address map on page 51). It can also be reset by the Smart Loader (refer to manual CP-UM-5319E).

■ Playback display data

The built-in RAM memory of the AUR350C accumulates a total of 10 seconds of data at 0.1 second intervals concerning shutter operation, flame voltage and number of discharges. The data can be output using the Smart Loader or through RS-485 communications. A memory buffer is allocated for the 10 seconds of data (hereafter referred to as playback data) and is continually updated. When updating is stopped by one of the triggers described below, the data about flame voltage, shutter operating cycle, etc., that accumulated in the memory for 10 seconds before the event trigger occurred can be checked. The event trigger, cumulative operation time and number of combustion starts are linked to the playback data. Selections can be set using the Smart Loader. Multiple event triggers can also be set.

● Event trigger selection

Setting	Name of trigger	Description
1	K2 OFF	When K2 is de-energized, the trigger is activated.
2	K3 ON	When K3 goes from OFF to ON, the trigger is activated.
3	K3 OFF	When K3 goes from ON to OFF, the trigger is activated.
4	Event occurrence	When an event occurs, the trigger is activated.
5	Flame voltage increase	When the flame voltage increases above the upper limit value during operation, the trigger is activated.
6	Flame voltage decrease	When the flame voltage decreases below the lower limit value during operation, the trigger is activated. (The trigger is not activated when K2 is OFF.)
7	Shutter-closed time exceeded	When the shutter-closed time exceeds the set value during operation, the trigger is activated. (The trigger is not activated when K2 is OFF.)
8	Shutter-open time exceeded	When the shutter-open time exceeds the set value during operation, the trigger is activated. (The trigger is not activated when K2 is OFF.)
9	Communications command	When "35AC" is written to address 3901W through RS-485 communications, the trigger is activated.

The initial setting is 2.

!| Handling Precautions

• Backup time for playback data is 4 hours or more at room temperature (the average value is 12 hours).

● Sub-settings related to event trigger setting (set by the Smart Loader)

Sub-settings	Range	Intial value	Description
Operation delay time	0.1 to 5.0s	1.0s	The length of time that the trigger conditions for flame voltage increase or decrease must continue before the trigger is activated.
Updating of playback		1 (update)	Four areas are allocated for playback data. This setting controls whether updating continues after the trigger has been activated 4 times.
Flame voltage upper limit value	0 to 5.0V	4.0V	Upper limit for flame voltage. When the flame voltage exceeds this value, the trigger is activated.
Flame voltage lower limit value	0 to 5.0V	1.5V	Flame voltage lower limit. When flame voltage falls below this value, the trigger is activated.
Shutter-closed time value	0.1 to 5.0s	3.0s	Upper limit for shutter-closed time. When the shutter-closed time exceeds this value, the trigger is activated.
Shutter-open time value	0.1 to 5.0s	3.0s	Upper limit for shutter-open time. When the shutter-open time exceeds this value, the trigger is activated.

■ Maintenance data

This includes event history (8 items), number of occurrences of each event, cumulative operating time, cumulative combustion time, cumulative number of combustion starts, operating time, combustion time, the number of combustion starts, AUR memo, etc. Event data can be read out by the Smart Loader or RS-485 communications.

Data item	Description
Event history	Eight ring buffers are available. They are linked to the operation time at event occurrence or the number of combustion starts.
Occurrences of each event (*1)	How many times the event occurred. Range = 0 to 255 times. (*1)
Cumulative operation time (*2)	The length of time that power was supplied. Range = 0 to 99,999 hrs.
Cumulative combustion time (*2)	The length of time that both K1 and K2 relays were ON. Range = 0 to 99,999 hrs.
Cumulative occurrences of combustion	Cumulative number of combustion starts. Range = 0 to 99,999 times
Operation time (*2)	The length of time that power was supplied. Range = 0 to 99,999 hrs. (for measurement purposes)
Combustion time (*2)	The length of time that both K1 and K2 relays were ON. Range = 0 to 99,999 hrs. (for measurement purposes)
Occurrences of combustion	Number of combustion starts. Range = 0 to 99,999 times (for measurement purposes)
AUR memo	A comment up to 60 words (upper case) can be written into the AUR memo by using the Smart Loader.
Flame voltage	Average value per second, average value per minute, maximum value, minimum value (during K2 ON).
Shutter operation cycle	Average value per minute, maximum value, minimum value (during K2 ON).
Relay operation	Feedback from K1, K2 and K3 relays.
Operation status	Event occurrence status, operation status

*1 The occurrences are counted regardless of whether the event was selected.

*2 The unit for time data is seconds. Cumulative operation time and operation time are the same.

Chapter 6. COMMUNICATIONS FUNCTIONS

6 - 1 Outline of Communications

Because the AUR350C is equipped with RS-485 communications capabilities, communications with a PC, PLC or other host device are available using a user-prepared program. Use the CPL protocol (Controller Peripheral Link: Yamatake's communications protocol).

■ **Features**

The features of the AUR350C communications functions are as follows:
- Up to 15 units can be connected to a single master station acting as a host device. The CMC10B communication converter (sold separately) is necessary to connect 16 units or more.
- If the host device uses an RS-232C interface, the CMC10L communications converter (sold separately) is required. The CMC10L converts between RS-232C and RS-485 communications.
- Random access commands are available. Parameters at addresses separated by a single command can be read or written.
- Maximum transmission speed is 19200bps.

■ **Initial setup**

The following items must be set up in adjustment mode to enable communications:

Setup item	Setup method	Parameter	Factory setting
Station address	Rotary switch	01 to 0F	00: No communication
Transmission speed	Smart Loader	0: 2400bps 1: 4800bps 2: 9600bps 3: 19200bps	3: 19200bps
Data format	Smart Loader	0: 8 bits, even parity, 1 stop bit 1: 8 bits, no parity, 2 stop bits	0: 8bits/ even parity/ 1stop bit
Minimum response time	Smart Loader	0: 1ms 1: 10ms 2: 100ms 3: 200ms	1: 10ms

■ Communications procedures

The communications procedure is as follows:

(1) An instructions is sent from the master station to the AUR350C (slave station).

(2) The slave station receives the instructions, and performs read or write processing according to the content of the message.

(3) The slave station sends a reply message corresponding to the processing content.

(4) The master station receives the response.

6 - 2 CPL Communications

■ Message structure

The following describes the message structure:

Messages are broadly classified into two layers: the data link layer and the application layer.

• Data link layer

This layer contains the basic information required for communications, such as the destination of the instruction message and the checksum information for the message.

• Application layer

Data is read and written in this layer. The content of the layer varies according to the purpose of the message.

Messages are composed of 9 parts as shown in the figure below.
The command (details sent from the master station) and the response (details returned from the slave station) are stored in the application layer.

02H		30H	30H	58H		03H		0DH	0AH
STX		0	0	X		ETX		CR	LF
(1)	(2)	(3)	(4)	(5)		(6)	(7)	(8)	(9)

Data link layer	Application layer	Data link layer

1 frame

(1) STX (start of message)
(2) Station address
(3) Sub-address
(4) Device code
(5) Instruction message (= command)
   or response

(6) ETX (end of command/response)
(7) Checksum
(8) CR (delimiter)
(9) LF (delimiter)

■ Data link layer

● Outline

The data link layer is of a fixed length. Generally the position of each data item and the number of its characters are fixed, but from ETX onwards the data positions shift according to the number of characters in the application layer.

● Response start conditions

The AUR350C (slave station) sends a response only when the message structures (station address, sub-address, checksum and message length of a single frame in the data link layer) are all correct. If even one of these is incorrect, the AUR350C does not send a response, but stands by to receive STX.

● **List of data link layer data definitions**

The following list shows the definitions for data in the data link layer:

Data name	Character code	Number of bytes	Description
STX	02H	1	Start of message
Station address	Hexadecimal 00 to 0FH	2	Identification of device to communicate with
Sub-address	"00" (30H, 30H)	2	No function
Device code	"X" (58H) or "x" (78H)	1	Device type
ETX	03H	1	End of the application layer
Checksum	Hexadecimal 00 to FFH	2	Checksum of message
CR	0DH	1	End of message (1)
LF	0AH	1	End of message (2)

● **Description of data items**

- STX (02H)

  When STX is received, the AUR350C concludes that an instruction message has begun. Therefore, it returns to the initial state from whatever reception state it was in, and processing is started taking STX as the first character received. The purpose of this is to enable the device to recover and respond to the next correct message (e.g. a RETRY message) from the master station in the event that noise, for example, causes an error in the previously sent message.

- Station address

  When the AUR350C receives instruction messages from the master station, it creates response messages only when the station addressed is itself. The station address in instruction messages is expressed as two-digit hexadecimal characters.

  The station address is set up by the rotary switch. However, when the station address is set to "00" (30H 30H), the AUR350C does not respond even if the station address of the instruction message is "00." When replying, the AUR350C returns the same station address that was received.

- Sub-address

  The AUR350C does not use sub-addresses. For this reason, it returns "00" as the sub-address in response messages.

- Device code

  The device code is either X (58H) or x (78H). This code is fixed for each device series, so a different are cannot be used. When replying the AUR350C returns the same device code that was received. It may be convenient to use X (58H) first, and then use x (78H) to differentiate a resent message.

- ETX (03H)

  ETX indicates the end of the application layer.

- Checksum

This value is for checking whether or not noise or other interference has changed the message content during communications. The checksum is expressed as a two-character hexadecimal number.

- How to calculate a checksum
  (1) Add the character codes in the message from STX through ETX byte by byte.
  (2) Take the 2's complement of the low-order byte of the addition result.
  (3) Convert the obtained 2's complement to a two-byte ASCII code.

- CR/LF

This indicates the end of the message. After LF is received, the processing of the received message starts immediately.

■ Application layer

The table below shows the composition of the application layer.

Item	Description
Command	"RS" (Continuous data read command for decimal numerals)
	"WS" (Continuous data write command for decimal numeralsl)
	"RD" (Continuous data read command for hexadecimal numerals)
	"WD" (Continuous data write command for hexadecimal numerals)
	"RU" (Random data read command for hexadecimal numerals)
	"WU" (Random data write command for hexadecimal numerals)
Data delimiter	RS, WS: "," (comma) RD, WD, RU, WU: None
Word address	RS, WS: "501W", etc. RD, WD, RU, WU: "01F5", etc.
Read numeric data	Numeric characters expressed as "1" for example.
Write numeric data	RS, WS: Numeric characters expressed as "100" for example. RD, WD, RU, WU: Numeric characters expressed in hexadecimal as "0064" for example.

● Number of word addresses accessible in a single frame

Type	Description of command	RAM area	EEPROM area
RS	Read command for decimal numerals	16	16
WS	Write command for decimal numerals	16	16
RD	Read command for hexadecimal numerals	32	32
WD	Write command for hexadecimal numerals	32	32
RU	Random read command for hexadecimal numerals	16	16
WU	Random write command for hexadecimal numerals	16	16

6 - 3   Description of Commands

■ Continuous data read command (RS command)

This command reads the content of continuous data addresses starting with the specified data start address.

● Instruction message

R	S	,	1	0	0	1	W	,	1
(1)		(2)			(3)			(2)	(4)

Application layer

(1) Command
(2) Data delimiter
(3) Data start address
(4) Read data count

● Response message

• Normal termination (reading of single data item)

0	0	,				
(1)		(2)			(3)	

• Normal termination (reading of multiple data items)

0	0	,				,			,			
(1)		(2)		(3)		(2)		(4)		(2)		(5)

• Abnormal termination

X	X
(1)	

The abnormal termination code is entered at XX.

(1) Termination code*
(2) Data delimiter
(3) Data 1
(4) Data 2 to (n-1)
(5) Data (n)

*For details of termination codes, refer to:

■ Continuous data write command (WS command)

This command writes the content of continuous data addresses starting with the specified data start address.

● **Instruction message**

W	S	,	3	0	0	0	W	,	1	,	0	2
(1)		(2)			(3)			(2)	(4)	(2)	(5)	

(1) Command
(2) Data delimiter
(3) Data start address
(4) Write data (1st word)
(5) Write data (2nd word)

● **Response message**

• Normal termination

0	0
(1)	

• Abnormal termination or warning

| X | X | The abnormal termination code is entered at XX.
|---|---|
| (1) | |

(1) Termination code*

*For details of termination codes, refer to:

■ Fixed length continuous data read command (RD command)

RD is a command to read continuous data in two-byte units. It is suitable for handling data in ladder programs sent by PLC communications, as the data is of a fixed length. The data start address is expressed as a hexadecimal number of four characters ("digits"). The number of data items is also expressed as four digits, and data is expressed as 4n (n is a positive integer) hexadecimal digits.

● Instruction message

The read data start address (four hexadecimal digits) and the read data count (four hexadecimal digits) are sent.

R D		
(1)	(2)	(3)

(1) Command
(2) Data start address
(3) Read data count

● Response message

If the message is received successfully, the normal termination code (two decimal digits) is returned along with the read data count (four hexadecimal digits times the number of items read) specified by the command. If the message was not received successfully, an abnormal termination code (two decimal digits) is returned without the read data appended.

• Normal termination (reading of single data item)

0 0	
(1)	(2)

• Normal termination (reading of multiple data items)

0 0			
(1)	(2)	(3)	(4)

• Abnormal termination

| X X | The abnormal termination code is entered at XX.
|---|
| (1) |

(1) Termination code*
(2) Data item 1
(3) Data items 2 to (n-1)
(4) Data item n

*For details of codes, refer to:
☞ 6-5, "List of Termination Codes" (page 43).

■ Fixed length continuous data write command (WD command)

WD is a command to write continuous data in two-byte units. It is suitable for handling data in ladder programs sent by PLC communications as the data is of a fixed length. The data start address is expressed as four hexadecimal digits. The data is expressed as 4n (n is a positive integer) hexadecimal digits.

● Instruction message

The write data start address (four hexadecimal digits) and the write data count (4n hexadecimal digits) are sent (n being the number of write data items)

● Response message

• Writing of a single data item

W : D		
(1)	(2)	(3)

• Writing of multiple data items

W : D				
(1)	(2)	(3)	(4)	(5)

(1) Command
(2) Data start address
(3) Data item 1
(4) Data items 2 to (n-1)
(5) Data item n

If writing is successful, the normal termination code (two decimal digits) is returned. If only a part of the data is written, a warning termination code (two decimal digits) is returned. If the data is not written at all, an abnormal termination code (two decimal digits) is returned.

• Normal termination

0 : 0
(1)

• Abnormal termination or warning termination

| X : X | The abnormal (warning) termination code is entered at XX.
|---|
| (1) |

(1) Termination code*

*For details of codes, refer to:

■ Fixed length random data read command (RU command)

This command reads random (non-continuous) data in two-byte units.

● Instruction message

The data addresses (four hexadecimal digits) of the data to be read are sent in the specified order.

R	U	0	0					)(					
(1)		(2)		(3)			(4)			(5)			

(1) Command
(2) Sub-command: fixed at "00".
(3) Data address 1
(4) Data addresses 2 to (n-1)
(5) Data address (n)

● Response message

If the message is received successfully, the normal termination code (two decimal digits) is returned along with the read data count (four hexadecimal digits times the number of data items) specified by the command. If the message was not received successfully, an abnormal termination code (two decimal digits) is returned without the read data appended.

• Normal termination

0	0					)(				
(1)		(2)			(3)			(4)		

• Abnormal termination

X	X
(1)	

The abnormal termination code is entered at XX.

(1) Termination code*
(2) Data item 1
(3) Data items 2 to (n-1)
(4) Data item n

*For details of codes, refer to:
☞ 6-5, "List of Termination Codes" (page 43).

■ Fixed length random data write command (WU command)

This command writes data to random (non-continuous) addresses in two-byte units. Data is expressed as four hexadecimal digits.

● Instruction message

Data is sent such that the address (four hexadecimal digits) of the data to be written and the data (four hexadecimal digits) form a pair.

W	U	0	0									
(1)		(2)		(3)		(4)				(5)		(6)

(1) Command
(2) Sub-command: fixed at "00"
(3) Data address 1
(4) Write data 1
(5) Data address n
(6) Write data n

● Response message

If writing is successful, the normal termination code (two decimal digits) is returned. If only part of the data is written, and the remaining data is not written, a warning termination code (two decimal digits) is returned. If none of the data is written, an abnormal termination code (two decimal digits) is returned.

• Normal termination

0	0
(1)	

• Abnormal termination or warning termination

| X | X | The abnormal (or warning) termination code is entered at XX.
|---|---|
| (1) | |

(1) Termination code*

*For details of codes, refer to:

6 - 4   Numeric Representation in the Application Layer

The specifications for numeric representation are variable-length (zero suppress) decimal for RS and WS commands and fixed-length hexadecimal for RD, WD, RU and WU commands. Details are as follows:

● **RS and WS commands**

Item	Specifications	Treatment of Abnormalities
Unnecessary space	Cannot be appended.	Message processing is aborted and an abnormal termination code is returned as a response message.
Unnecessary zero	Cannot be appended.	
Numerical value = zero	Cannot be omitted. Be sure to use "0."	
Other unnecessary characters	Numerical values may be prefixed with a "-" expressing a negative number. Any other character cannot be appended. The "+" sign must not be appended to indicate positive numerical values.	
Range of available numerical values	-32768 to +32767. Values outside of this are not allowed.	

● **RD, WD, RU and WU commands**

Item	Specifications	Treatment of Abnormalities
Unnecessary space	Cannot be appended.	Message processing is aborted and an abnormal termination code is returned as a response message.
Unnecessary zero	Cannot be appended.	
Numerical value = zero	Cannot be omitted. Be sure to use "0000."	
Other unnecessary characters	Cannot be appended.	
Range of available numerical values	0000H to FFFFH	

6 - 5   List of Termination Codes

The termination code must be returned in a response message.

Termination code	Type	Description	Treatment of Abnormalities	Example
00	Normal	Normal termination	(All processing was completed normally.)	
99	Abnormal	Undefined command	Only the termination code is returned and message processing is not performed.	AA,1001W,1 RX03E80001
22	Warning	The value of the written data is out of the specified range.	Processing continues except for the data address concerned	WS,2001W,3000
23	Warning	Writing disabled due to instrument settings, instrument external conditions, etc.	Processing continues except for the data address concerned.	
40	Abnormal	Read data count error	Only the termination code is returned and message processing is not performed.	RS,1001W,A RD03E9000Z
41	Abnormal	• Data address is out of range. • Conversion error • Outside of the range of -32768 to +32767	Only the termination code is returned and message processing is not performed.	RS,100000W,1 WD0XXX0001
42	Warning	• Value of data is out of range. • Data error • Data length exceeds one word.	Processing is performed up to the data address concerned; the succeeding processing is not performed.	WS,2001W,100,XXX WS,2001W,100000 WD03E900010XXX

6 - 6   Transmission and Reception Timing

■ Timing specifications for instruction message and response message

The obligatory instructions below concern the timing of instruction message transmission from the master station and response message transmission from the slave station.
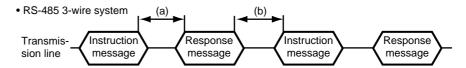
● Response monitor time

The maximum time between the end of the instruction message transmission by the master station and the start of reception of the response message from the slave station is two seconds ("a" in the figure below). Therefore the response monitor time should be set to two seconds.

Resend the instruction message if a response time-out occurs.

● Transmission start time
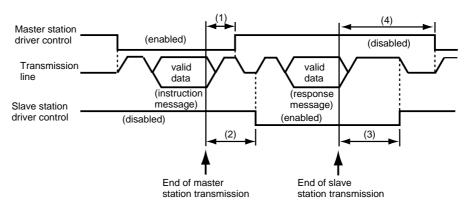
A wait time of 10ms is required before the master station starts to transmit the next instruction message (to the same slave station or a different slave station) after reception of a response message has ended ("b" in the figure below).

• RS-485 3-wire system

Transmission line

| Instruction message | (a) | Response message | (b) | Instruction message | Response message |

(a) End of master station transmission -
    transmission start time of slave station = max. 2000ms
(b) End of slave station transmission -
    transmission start time of master station = min. 10ms

■ RS-485 driver control timing specifications

When the transmission/reception on the RS-485 3-wire system is directly controlled by the master station, care should be paid to the following timing:

Master station driver control (enabled) (disabled)

Transmission line — valid data (instruction message) — valid data (response message)

Slave station driver control (disabled) (enabled)

End of master station transmission

End of slave station transmission

(1) End of master station transmission - time until driver disabled = max. 500μs
(2) End of slave station reception - time until driver enabled = min. 1ms
(3) End of slave station transmission - time until driver disabled = max. 10ms
(4) End of master station reception - time until driver enabled = min. 10ms

6 - 7   Definition of Data Addresses

● **RAM and EEPROM data address areas**

Data addresses are categorized as follows:

Data address	Name	Remarks
1000W to 4999W	RAM data addresses	Reading and writing of these addresses are both performed in RAM. Since writing is performed to RAM the value returns to that stored in EEPROM when the power is re-supplied.
5000W to 8999W	EEPROM data addresses	Reading and writing are both performed in EEPROM.

☒ **Handling Precautions**

- The number of times that EEPROM can be rewritten is limited (100,000 operations). Accordingly, it is advisable to write parameters that are rewritten extremely frequently to RAM, which can be infinitely overwritten . However, when using RAM, remember that data in EEPROM is transferred to RAM when power is resupplied.

● **Writing data range**

If the writing value exceeds the range determined by parameters, writing is not performed and an abnormal termination code is returned.

● **Writing conditions**

An abnormal termination code is also returned when writing is not performed due to conditions.

6 - 8   Address Map

■ Address map

The following symbols are used in the read/write columns for RAM/EEPROM:
●: Possible
X: Not possible

Item	RAM address Decimal	RAM address Hex.	EEPROM address Decimal	EEPROM address Hex.	RAM Read	RAM Write	EEPROM Read	EEPROM Write	Remarks

Operation state	1000W	03E8H			●	X			0 to 3
									0: During stop (K1, K2 OFF)
									1: During ignition trial
									  (K1 ON)
									2: During operation
									  (K1, K2 ON)
									3: During false flame
									  (K2 ON)

Event occurrence status	1001W	03E9H			●	X			Bit 0: Event 1 Bit 1: Event 2 Bit 2: Event 3 Bit 3: Event 4 Bit 4: Event 5 Bit 5: Event 6 Bit 6: Event 7 Bit 7: Event 8 (1: occurrence, 0: non occurrence)
Current flame voltage	1002W	03EAH			●	X			0 to 500 (5.00V)
Maximum flame voltage	1003W	03EBH			●	X			Value is expanded 100 times.

Minimum flame voltage	1004W	03ECH			●	X			0 to 500 (5.00V)
									Value is expanded 100
									  times.
									Measurement starts 15s
									  after K2 ON.
									Updated every 4s.

Av. flame voltage/s	1005W	03EDH			●	X			0 to 500 (5.00V)
Av. flame voltage/s	1006W	03EEH			●	X			Value is expanded 100 times.
	1007W	03EFH			●	X			
	1008W	03F0H			●	X			
	1009W	03F1H			●	X			
	1010W	03F2H			●	X			
No. of shutter closures/s	1011W	03F3H			●	X			0 to 60 times (per second)
Max. No. of shutter closures	1012W	03F4H			●	X			
Min. No. of shutter closures	1013W	03F5H			●	X			
No. of shutter closures/min	1014W	03F6H			●	X			0 to 3600 times (per minute)
Shutter on-off cycle	1015W	03F7H			●	X			0 to 5000 (5.000s)
Maximum shutter on-off cycles	1016W	03F8H			●	X			Value is expanded 1000
Minimum shutter on-off cycles	1017W	03F9H			●	X			times.
Av. shutter on-off cycles/min	1018W	03FAH			●	X			

Item		RAM address Decimal	RAM address Hex.	EEPROM address Decimal	EEPROM address Hex.	RAM Read	RAM Write	EEPROM Read	EEPROM Write	Remarks
Feedback	K1_FB	1070W	042EH			●	X			0: OFF, 1: ON
	K2_FB	1071W	042FH			●	X			
	K3_FB	1072W	0430H			●	X			
Amt. of time/No. of times	Cum. op. time (lower byte)	1100W	044CH	5100W	13ECH	●	●	●	●	0 to 99999h
	Cum. op. time (upper byte)	1101W	044DH	5101W	13EDH	●	●	●	●	(Time is incremented by
	Cum. burn time (lower byte)	1102W	044EH	5102W	13EEH	●	●	●	●	the second.)
	Cum. burn time (upper byte)	1103W	044FH	5103W	13EFH	●	●	●	●	
	Cum. No. of burn times (lower byte)	1104W	0450H	5104W	13F0H	●	●	●	●	0 to 99999 times
	Cum. No. of burn times (upper byte)	1105W	0451H	5105W	13F1H	●	●	●	●	
	Operating time (lower byte)	1106W	0452H	5106W	13F2H	●	●	●	●	0 to 99999h
	Operating time (upper byte)	1107W	0453H	5107W	13F3H	●	●	●	●	(Time is incremented by
	Burn time (lower byte)	1108W	0454H	5108W	13F4H	●	●	●	●	the second.)
	Burn time (upper byte)	1109W	0455H	5109W	13F5H	●	●	●	●	
	No. of burn times (lower byte)	1110W	0456H	5110W	13F6H	●	●	●	●	0 to 99999 times
	No. of burn times (upper byte)	1111W	0457H	5111W	13F7H	●	●	●	●	
Inspection period current value	State of request for inspection period	1120W	0460H			●	X			Bit 0: Request for insp. per. 1 Bit 1: Request for insp. per. 2 Bit 2: Request for insp. per. 3 Bit 3: Request for insp. per. 4 (1: request, 0: no request)
	Insp. per. 1 (lower byte)	1121W	0461H	5121W	1401H	●	●	●	●	0 to 99999 hours/times
	Insp. per. 1 (upper byte)	1122W	0462H	5122W	1402H	●	●	●	●	(Time is incremented by
	Insp. per. 2 (lower byte)	1123W	0463H	5123W	1403H	●	●	●	●	the second.)
	Insp. per. 2 (upper byte)	1124W	0464H	5124W	1404H	●	●	●	●	
	Insp. per. 3 (lower byte)	1125W	0465H	5125W	1405H	●	●	●	●	
	Insp. per. 3 (upper byte)	1126W	0466H	5126W	1406H	●	●	●	●	
	Insp. per. 4 (lower byte)	1127W	0467H	5127W	1407H	●	●	●	●	
	Insp. per. 4 (upper byte)	1128W	0468H	5128W	1408H	●	●	●	●	
Event record — Record 1	Event code	2000W	07D0H	6000W	1770H	●	●	●	●	1 to 8 1: E1 2: E2 3: E3 4: E4 5: E5 6: E6 7: E7 8: E8
	No. of burn times (lower byte)	2001W	07D1H	6001W	1771H	●	●	●	●	Number of burn times
	No. of burn times (upper byte)	2002W	07D2H	6002W	1772H	●	●	●	●	before event happened.
	Op. time (lower byte)	2003W	07D3H	6003W	1773H	●	●	●	●	Amt. of operating time when
	Op. time (upper byte)	2004W	07D4H	6004W	1774H	●	●	●	●	event happened.
	Checksum of record 1	2005W	07D5H	6005W	1775H	●	●	●	●	Add data from event code to upper byte of op. time (by byte), then invert the sum.
Event record — Record 2	Event code	2006W	07D6H	6006W	1776H	●	●	●	●	Same as record 1
	No. of burn times (lower byte)	2007W	07D7H	6007W	1777H	●	●	●	●	
	No. of burn times (upper byte)	2008W	07D8H	6008W	1778H	●	●	●	●	
	Op. time (lower byte)	2009W	07D9H	6009W	1779H	●	●	●	●	
	Op. time (upper byte)	2010W	07DAH	6010W	177AH	●	●	●	●	
	Checksum of record 2	2011W	07DBH	6011W	177BH	●	●	●	●	

Item			RAM address		EEPROM address		RAM		EEPROM		Remarks
			Decimal	Hex.	Decimal	Hex.	Read	Write	Read	Write	
Event record	Record 3	Event code	2012W	07DCH	6012W	177CH	●	●	●	●	Same as record 1
		No. of burn times (lower byte)	2013W	07DDH	6013W	177DH	●	●	●	●	
		No. of burn times (upper byte)	2014W	07DEH	6014W	177EH	●	●	●	●	
		Op. time (lower byte)	2015W	07DFH	6015W	177FH	●	●	●	●	
		Op. time (upper byte)	2016W	07E0H	6016W	1780H	●	●	●	●	
		Checksum of record 3	2017W	07E1H	6017W	1781H	●	●	●	●	
	Record 4	Event code	2018W	07E2H	6018W	1782H	●	●	●	●	Same as record 1
		No. of burn times (lower byte)	2019W	07E3H	6019W	1783H	●	●	●	●	
		No. of burn times (upper byte)	2020W	07E4H	6020W	1784H	●	●	●	●	
		Op. time (lower byte)	2021W	07E5H	6021W	1785H	●	●	●	●	
		Op. time (upper byte)	2022W	07E6H	6022W	1786H	●	●	●	●	
		Checksum of record 4	2023W	07E7H	6023W	1787H	●	●	●	●	
	Record 5	Event code	2024W	07E8H	6024W	1788H	●	●	●	●	Same as record 1
		No. of burn times (lower byte)	2025W	07E9H	6025W	1789H	●	●	●	●	
		No. of burn times (upper byte)	2026W	07EAH	6026W	178AH	●	●	●	●	
		Op. time (lower byte)	2027W	07EBH	6027W	178BH	●	●	●	●	
		Op. time (upper byte)	2028W	07ECH	6028W	178CH	●	●	●	●	
		Checksum of record 5	2029W	07EDH	6029W	178DH	●	●	●	●	
	Record 6	Event code	2030W	07EEH	6030W	178EH	●	●	●	●	Same as record 1
		No. of burn times (lower byte)	2031W	07EFH	6031W	178FH	●	●	●	●	
		No. of burn times (upper byte)	2032W	07F0H	6032W	1790H	●	●	●	●	
		Op. time (lower byte)	2033W	07F1H	6033W	1791H	●	●	●	●	
		Op. time (upper byte)	2034W	07F2H	6034W	1792H	●	●	●	●	
		Checksum of record 6	2035W	07F3H	6035W	1793H	●	●	●	●	
	Record 7	Event code	2036W	07F4H	6036W	1794H	●	●	●	●	Same as record 1
		No. of burn times (lower byte)	2037W	07F5H	6037W	1795H	●	●	●	●	
		No. of burn times (upper byte)	2038W	07F6H	6038W	1796H	●	●	●	●	
		Op. time (lower byte)	2039W	07F7H	6039W	1797H	●	●	●	●	
		Op. time (upper byte)	2040W	07F8H	6040W	1798H	●	●	●	●	
		Checksum of record 7	2041W	07F9H	6041W	1799H	●	●	●	●	
	Record 8	Event code	2042W	07FAH	6042W	179AH	●	●	●	●	Same as record 1
		No. of burn times (lower byte)	2043W	07FBH	6043W	179BH	●	●	●	●	
		No. of burn times (upper byte)	2044W	07FCH	6044W	179CH	●	●	●	●	
		Op. time (lower byte)	2045W	07FDH	6045W	179DH	●	●	●	●	
		Op. time (upper byte)	2046W	07FEH	6046W	179EH	●	●	●	●	
		Checksum of record 8	2047W	07FFH	6047W	179FH	●	●	●	●	
Event pointer			2048W	0800H	6048W	17A0H	●	●	●	●	0 to 7 0:→Renewing record 1 (current record is 8) 1:→Renewing record 2 2:→Renewing record 3 3:→Renewing record 4 4:→Renewing record 5 5:→Renewing record 6 6:→Renewing record 7 7:→Renewing record 8 (current record is 7)
No. of event occurrences		E1: False flame	2500W	09C4H	6500W	1964H	●	●	●	●	Number of event occurrences (0 to 255 times)
		E2: K2 off (shutter closed)	2501W	09C5H	6501W	1965H	●	●	●	●	
		E3: Shutter closed during op.	2502W	09C6H	6502W	1966H	●	●	●	●	
		E4: Short betw. terminals F and G	2503W	09C7H	6503W	1967H	●	●	●	●	
		E5: Flame voltage drop	2504W	09C8H	6504W	1968H	●	●	●	●	
		E6: K2 off (shutter open)	2505W	09C9H	6505W	1969H	●	●	●	●	
		E7: For maintenance									
		E8: For maintenance									

Item		RAM address		EEPROM address		RAM		EEPROM		Remarks
		Decimal	Hex.	Decimal	Hex.	Read	Write	Read	Write	
Insp. per. selection	Operation of insp. per. 1	3000W	0BB8H	7000W	1B58H	●	●	●	●	0 to 3
	Operation of insp. per. 2	3001W	0BB9H	7001W	1B59H	●	●	●	●	0: Unselected
	Operation of insp. per. 3	3002W	0BBAH	7002W	1B5AH	●	●	●	●	1: Operating time
	Operation of insp. per. 4	3003W	0BBBH	7003W	1B5BH	●	●	●	●	2: Burn time
										3: Number of burn times
	Initializing current inspection periods 1 to 4	3004W	0BBCH	7004W	1B5CH	●	●			Refer to 3802W
Inspection period configuration	Op. time setting 1-1 (lower byte)	3010W	0BC2H	7010W	1B62H	●	●	●	●	0 to 99999h
	Op. time setting 1-1 (upper byte)	3011W	0BC3H	7011W	1B63H	●	●	●	●	(Time is incremented by the
	Burn time setting 1-2 (lower byte)	3012W	0BC4H	7012W	1B64H	●	●	●	●	second.)
	Burn time setting 1-2 (upper byte)	3013W	0BC5H	7013W	1B65H	●	●	●	●	
	No. of burn times 1-3 (lower byte)	3014W	0BC6H	7014W	1B66H	●	●	●	●	0 to 99999 times
	No. of burn times 1-3 (upper byte)	3015W	0BC7H	7015W	1B67H	●	●	●	●	
	Op. time setting 2-1 (lower byte)	3016W	0BC8H	7016W	1B68H	●	●	●	●	0 to 99999h
	Op. time setting 2-1 (upper byte)	3017W	0BC9H	7017W	1B69H	●	●	●	●	(Time is incremented by the
	Burn time setting 2-2 (lower byte)	3018W	0BCAH	7018W	1B6AH	●	●	●	●	second.)
	Burn time setting 2-2 (upper byte)	3019W	0BCBH	7019W	1B6BH	●	●	●	●	
	No. of burn times 2-3 (lower byte)	3020W	0BCCH	7020W	1B6CH	●	●	●	●	0 to 99999 times
	No. of burn times 2-3 (upper byte)	3021W	0BCDH	7021W	1B6DH	●	●	●	●	
	Op. time setting 3-1 (lower byte)	3022W	0BCEH	7022W	1B6EH	●	●	●	●	0 to 99999h
	Op. time setting 3-1 (upper byte)	3023W	0BCFH	7023W	1B6FH	●	●	●	●	(Time is incremented by the
	Burn time setting 3-2 (lower byte)	3024W	0BD0H	7024W	1B70H	●	●	●	●	second.)
	Burn time setting 3-2 (upper byte)	3025W	0BD1H	7025W	1B71H	●	●	●	●	
	No. of burn times 3-3 (lower byte)	3026W	0BD2H	7026W	1B72H	●	●	●	●	0 to 99999 times
	No. of burn times 3-3 (upper byte)	3027W	0BD3H	7027W	1B73H	●	●	●	●	
	Op. time setting 4-1 (lower byte)	3028W	0BD4H	7028W	1B74H	●	●	●	●	0 to 99999h
	Op. time setting 4-1 (upper byte)	3029W	0BD5H	7029W	1B75H	●	●	●	●	(Time is incremented by the
	Burn time setting 4-2 (lower byte)	3030W	0BD6H	7030W	1B76H	●	●	●	●	second.)
	Burn time setting 4-2 (upper byte)	3031W	0BD7H	7031W	1B77H	●	●	●	●	
	No. of burn times 4-3 (lower byte)	3032W	0BD8H	7032W	1B78H	●	●	●	●	0 to 99999 times
	No. of burn times 4-3 (upper byte)	3033W	0BD9H	7033W	1B79H	●	●	●	●	
Event configuration	E1: False flame	3040W	0BE0H	7040W	1B80H	●	●	●	●	0: Unselected
	E2: K2 off (shutter closed)	3041W	0BE1H	7041W	1B81H	●	●	●	●	1: Selected
	E3: Shutter closed during op.	3042W	0BE2H	7042W	1B82H	●	●	●	●	
	E4: Short betw. terminals F and G	3043W	0BE3H	7043W	1B83H	●	●	●	●	
	E5: Flame voltage drop	3044W	0BE4H	7044W	1B84H	●	●	●	●	
	E6: K2 off (shutter open)	3045W	0BE5H	7045W	1B85H	●	●	●	●	
	E7: For maintenance									
	E8: For maintenance									
	Shutter closure duration	3048W	0BE8H	7048W	1B88H	●	●	●	●	1 to 50 (5.0s)
	Flame voltage drop time	3049W	0BE9H	7049W	1B89H	●	●	●	●	Value is expanded 10 times.
	Flame voltage drop threshold	3050W	0BEAH	7050W	1B8AH	●	●	●	●	0 to 50 (5.0V)
										Value is expanded 10 times.
	Initializing event record	3051W	0BEBH	7051W	1B8BH	●	●			Refer to 3803W
	Initializing event	3052W	0BECH	7052W	1B8CH	●	●			Refer to 3804W

Item		RAM address		EEPROM address		RAM		EEPROM		Remarks
		Decimal	Hex.	Decimal	Hex.	Read	Write	Read	Write	
LED display setting	Upon event occurrence	3060W	0BF4H	7060W	1B94H	●	●	●	●	0: Unselected
	Flame voltage level	3061W	0BF5H	7061W	1B95H	●	●	●	●	1: Selected
	Request for inspection per. 1	3062W	0BF6H	7062W	1B96H	●	●	●	●	
	Request for inspection per. 2	3063W	0BF7H	7063W	1B97H	●	●	●	●	
	Request for inspection per. 3	3064W	0BF8H	7064W	1B98H	●	●	●	●	
	Request for inspection per. 4	3065W	0BF9H	7065W	1B99H	●	●	●	●	
K3 relay setting	Synchronized with K1 relay	3066W	0BFAH	7066W	1B9AH	●	●	●	●	0: Unselected
	Synchronized with K2 relay	3067W	0BFBH	7067W	1B9BH	●	●	●	●	1: Selected
	Upon event occurrence	3068W	0BFCH	7068W	1B9CH	●	●	●	●	
	Upper flame voltage	3069W	0BFDH	7069W	1B9DH	●	●	●	●	
	Lower flame voltage	3070W	0BFEH	7070W	1B9EH	●	●	●	●	
	Request for inspection per. 1	3071W	0BFFH	7071W	1B9FH	●	●	●	●	
	Request for inspection per. 2	3072W	0C00H	7072W	1BA0H	●	●	●	●	
	Request for inspection per. 3	3073W	0C01H	7073W	1BA1H	●	●	●	●	
	Request for inspection per 4	3074W	0C02H	7074W	1BA2H	●	●	●	●	
	Communications command	3075W	0C03H	7075W	1BA3H	●	●	●	●	
	ON delay time	3076W	0C04H	7076W	1BA4H	●	●	●	●	1 to 50 (5.0s)
	OFF delay time	3077W	0C05H	7077W	1BA5H	●	●	●	●	Value is expanded 10 times.
	Upper flame voltage setting	3078W	0C06H	7078W	1BA6H	●	●	●	●	0 to 50 (5.0V)
	Lower flame voltage setting	3079W	0C07H	7079W	1BA7H	●	●	●	●	Value is expanded 10 times.
Playback trigger setting	K2 OFF	3080W	0C08H	7080W	1BA8H	●	●	●	●	0: Unselected
	K3 ON	3081W	0C09H	7081W	1BA9H	●	●	●	●	1: Selected
	K3 OFF	3082W	0C0AH	7082W	1BAAH	●	●	●	●	
	Upon event occurrence	3083W	0C0BH	7083W	1BABH	●	●	●	●	
	Flame voltage increase	3084W	0C0CH	7084W	1BACH	●	●	●	●	
	Flame voltage drop	3085W	0C0DH	7085W	1BADH	●	●	●	●	
	Shutter closure time	3086W	0C0EH	7086W	1BAEH	●	●	●	●	
	Shutter open time	3087W	0C0FH	7087W	1BAFH	●	●	●	●	
	Communications command	3088W	0C10H	7088W	1BB0H	●	●	●	●	
	Playback screen renewal	3089W	0C11H	7089W	1BB1H	●	●	●	●	0: Unrenewable 1: Renewable
	Operation delay time	3090W	0C12H	7090W	1BB2H	●	●	●	●	1 to 50 (5.0s) Value is expanded 10 times.
	Flame voltage increase setting	3091W	0C13H	7091W	1BB3H	●	●	●	●	0 to 50 (5.0V)
	Flame voltage drop setting	3092W	0C14H	7092W	1BB4H	●	●	●	●	Value is expanded 10 times.
	Shutter closure time setting	3093W	0C15H	7093W	1BB5H	●	●	●	●	1 to 50 (5.0 second)
	Shutter open time setting	3094W	0C16H	7094W	1BB6H	●	●	●	●	Value is expanded 10 times.
Other	Resetting maximum and minimum values	3500W	0DACH			●	●			"C3A1"→Flame voltage "C3A2"→Number of discharges "C3A3"→Number of shutter closures "C3A4"→Shutter on-off cycles "C3A5"→Reset all WD/WU commands (hex.)
	Initializing playback display renewal	3501W	0DADH			●	●			"CA53"→Initialization WD/WU commands (hex.)

	Item	RAM address Decimal	Hex.	EEPROM address Decimal	Hex.	RAM Read	Write	EEPROM Read	Write	Remarks
Initialization	Cumulative operating time / cumulative number of burn times	3800W	0ED8H			●	●			"A5C1"→Cum. operating time "A5C2"→Cum. burn time "A5C3"→No. of burn times "A5C4"→All WD/WU commands (hex.)
	Initialization time	3801W	0ED9H			●	●			"A5C1"→Operating time "A5C2"→Burn time "A5C3"→No. of burn times "A5C4"→All WD/WU commands (hex.)
	Initialization of current inspection periods 1 to 4	3802W	0EDAH			●	●			"3CA1"→Inspection per. 1 "3CA2"→Inspection per. 2 "3CA3"→Inspection per. 3 "3CA4"→Inspection per. 4 "3CA5"→All WD/WU commands (hex.)
	Event record initialization	3803W	0EDBH			●	●			"AC53"→Record initialization WD/WU commands (hex.)
	Initialization of the number of events	3804W	0EDCH			●	●			"AC51"→Event 1 "AC52"→Event 2 "AC53"→Event 3 "AC54"→Event 4 "AC55"→Event 5 "AC56"→Event 6 "AC57"→Event 7 "AC58"→Event 8 "AC59"→All events WD/WU commands (hex.)
	Event resetting	3805W	0EDDH			●	●			"CA53"→Event resetting (except E1/E4) WD/WU commands (hex.)
Communications commands	Operation of the event relay	3900W	0F3CH			●	●			"35AC"→ON "A35C"→OFF WD/WU commands (hex.)
	Activation of an event trigger	3901W	0F3DH			●	●			"35AC"→ON WD/WU commands (hex.)
Communications setup	Data format	4000W	0FA0H	8000W	1F40H	●	●	●	●	0: 8 bits, even parity, 1 stop bit 1: 8 bits, no parity, 2 stop bits
	Transmission speed	4001W	0FA1H	8001W	1F41H	●	●	●	●	0: 2400bps 1: 4800bps 2: 9600bps 3: 19200bps
	Minimum response time	4002W	0FA2H	8002W	1F42H	●	●	●	●	0: 1ms 1: 10ms 2: 100ms 3: 200ms
	Station address	4003W	0FA3H	8003W	1F43H	●	●	●	●	Address: initial value is "00" (no communication)
AUR memo	Comment	4100W	1194H	8100W	1FA4H	●	●	●	●	
		↓	↓	↓	↓	↓	↓	↓	↓	
		4159W	11CFH	8159W	1FDFH	●	●	●	●	

Chapter 7. MAINTENANCE AND INSPECTION

⚠ WARNING

❗ Before mounting or removing the AUR350C, be sure to turn the power OFF. Failure to do so may cause an electric shock.

⚠ CAUTION

❗ Only authorized personnel who have technical skills with combustion equipment and flame safeguard control should carry out the mounting, wiring, inspection, adjustment, and maintenance work.

❗ If the safety shutoff is activated and the equipment is restarted, inspect all the items on the checklists in Chapter 4, "Trial-Run Adjustment."

❗ When performing the maintenance and inspection of the burner, always carry out the pilot turndown test. Inspection must be carried out once a year or more frequently.

❗ When cleaning the burner, also clean the AUD300C.

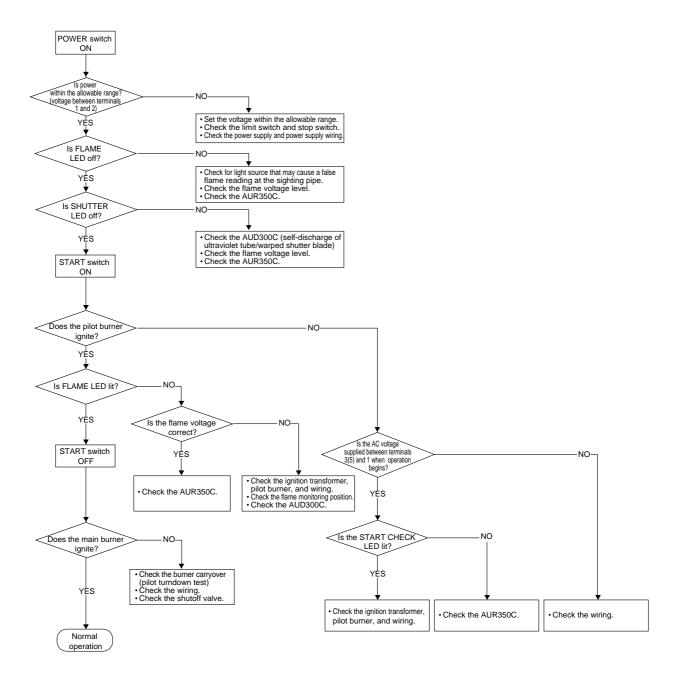■ **Frequency of maintenance and inspection**

Determine an appropriate frequency for maintenance and inspection work by considering the equipment type, ambient conditions (dust or temperature) of the location, and damage or negative effects if the burner is shutoff for some reason during operation of the equipment.

Inspections	Inspection frequency
Safety shutoff test (for details, refer to Chapter 4, "Trial-Run Adjustment").	Once a month or more
Contamination of monitoring window and sighting pipe of AUD300C	Once a month or more
Measurement of flame voltage	Once a month or more
Pilot turndown test	Once a year or more

⚠ **Handling Precautions**

• If unintended burner shutoff may cause a serious problem, perform the inspection more frequently.

• If the burner manufacturer provides specific instructions about maintenance and inspection, always strictly observe them.
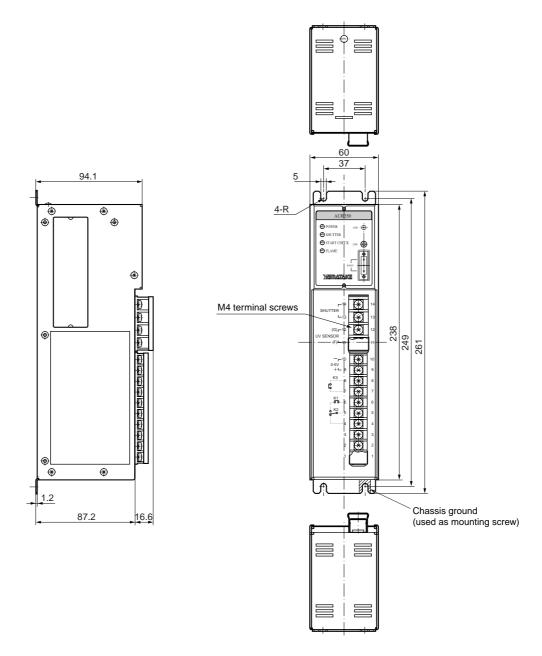
● **Fault inspection flowchart**

POWER switch ON

Is power within the allowable range? (voltage between terminals 1 and 2)
— NO →
• Set the voltage within the allowable range.
• Check the limit switch and stop switch.
• Check the power supply and power supply wiring.

YES

Is FLAME LED off?
— NO →
• Check for light source that may cause a false flame reading at the sighting pipe.
• Check the flame voltage level.
• Check the AUR350C.

YES

Is SHUTTER LED off?
— NO →
• Check the AUD300C (self-discharge of ultraviolet tube/warped shutter blade)
• Check the flame voltage level.
• Check the AUR350C.

YES

START switch ON

Does the pilot burner ignite?
— NO →

YES

Is FLAME LED lit?
— NO →

Is the flame voltage correct?
— NO →
• Check the ignition transformer, pilot burner, and wiring.
• Check the flame monitoring position.
• Check the AUD300C.

YES
• Check the AUR350C.

Is the AC voltage supplied between terminals 3(5) and 1 when operation begins?
— NO →
• Check the wiring.

YES

Is the START CHECK LED lit?
— NO →
• Check the AUR350C.

YES
• Check the ignition transformer, pilot burner, and wiring.

YES

START switch OFF

Does the main burner ignite?
— NO →
• Check the burner carryover (pilot turndown test)
• Check the wiring.
• Check the shutoff valve.

YES

Normal operation

Chapter 8.   SPECIFICATIONS

■ Specifications

Item	Description	
Model number	AUR350C13100/C13200	AUR350C12100/C12200
Flame response time	Nominal 3s (max. 4s) at flame voltage of 3V	Nominal 1.5s (max. 2s) at flame voltage of 3V
Flame voltage range (at rated voltage)	When a flame is present: 1.2 to 4.0Vdc Upon loss of flame: 0.0 to 0.6Vdc	When a flame is present: 1.7 to 4.0Vdc Upon loss of flame: 0.0 to 0.6Vdc
Recommended flame voltage	Stable between 1.5 to 4.0Vdc, when a flame is present.	Stable between 2.0 to 4.0Vdc, when a flame is present.
Combined flame detector	AUD300C1000/2000	
Rated power supply voltage	100Vac or 200Vac at 50/60Hz	
Allowable voltage range	85 to 110% of rated power supply voltage	
Power consumption	10W max. (including the power supply for the AUD300C)	
Dielectric strength	1500Vac 50/60Hz for 1 min or 1800Vac 50/60Hz for 1s Between ground and primary terminals 1 to 8 (not terminals 9 to 14).	
Insulation resistance	100MΩ min. by 500Vdc megger Between ground and primary terminals 1 to 8 (not terminals 9 to 14).	
Inductive lightning	10kV, 1.2/50μs (JEC-187: 75Ω min. surge impedance) The surge absorber listed below must be connected between the power supply terminal (1) and the ground. • Recommended surge absorber: part No. 83968019-001	
Service life	7 years or 100,000 cycles (operation cycles of each relay)	
Communications	Signal level:	RS-485-compliant
	Transmission line connection:	Multipoint (maximum 15 slave stations for 1 master station)
	Communication method:	Half-duplex
	Synchronous method:	Start-stop synchronization
	Transmission control:	Polling selecting method
	Transmission distance:	500m
	Transmission line:	3-wire system
	Transmission speed error:	0.16% or less
	Transmission speed:	2400, 4800, 9600, 19200bps
	Data length:	8 bits
	Stop bit length:	1 bit
	Parity:	Even or no parity
Ambient temperature	-20 to +60°C	
Storage temperature	-20 to +70°C	
Ambient humidity	90% RH at 40°C (no condensation allowed)	
Vibration resistance	4.9m/s^2 max., 10 to 55Hz for 2h each in X, Y and Z directions	
Mounting	Wall mounted (vertically or horizontally)	
Color	White	
Mass	Approx. 1.2kg	

■ Dimensions

94.1

1.2

87.2   16.6

60

37

5

4-R

AUR350

POWER
SHUTTER
START CHECK
FLAME

ADR

LDO

RS485

M4 terminal screws

SHUTTER
14
13
(G) 12
UV SENSOR
(F) 11

0-5V
K3
K1
K2

238

249

261

Chassis ground
(used as mounting screw)

Revision History

Printed date	Manual Number	Edition	Revised pages	Description
Apr. 2005	CP-SP-1175E	1st Edition		